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COMETS AND METEORS.

By RICHARD A. PROCTOR.

THERE is a marked contrast between our present knowledge respecting meteors and that which astronomers possessed before 1866, when Professor Newton, of Yale College, announced that the earth would pass through a rich part of a certain meteor-system on the night of the 13th-14th November, 1866. I am not here referring to the recognition of the nature of meteors as extra-terrestrial bodies. Too often the credit of this recognition is assigned to the astronomers who, during the last quarter of a century, have done so much to advance our knowledge beyond that point. But, in reality, Professor Olmsted, of Newhaven, Conn., had proved conclusively that meteors are non-telluric bodies, long before the modern school of meteoric astronomers had entered on their labours, and to him the whole credit of that part of the work of research must be assigned. His reasoning was perfectly demonstrative, though he did not succeed in convincing many of his contemporaries, or even in attracting their attention in any marked degree. Many in his day followed a custom which is common enough now, and regarded as suggestive of eminent caution and scientific prudence. Carefully avoiding any real expression of opinion, they remarked safely that "Prof. Olmsted's reasoning was worthy of careful consideration, though we are far from admitting that the startling theory to which his reasoning seems to point is a sound one: possibly the facts on which he insists may be explained in some other way." That theory had, however, been in reality demonstrated; and it now forms part of the basis on which meteoric astronomy stands.

An outline of his reasoning can be easily and briefly presented:—The 10th-11th of August and the 13th-14th of November are days on which meteor-showers may be looked for. But a particular day in the year is the time when the earth reaches a particular part of her orbit. Therefore certain parts of our earth's track are, as it were, infested by meteors. Now there is no possible way in which this can be brought about but by the passage of meteors, in flights or systems, across the track of the earth at those particular places. In the striking words of Alexander Humboldt, who (though he was never much of an astronomer) was keen-sighted enough to see the force of Olmsted's reasoning, which many astronomers overlooked, "the meteors before their encounter with our earth may be described as 'pocket planets.'"

The argument needed no clinching, but Olmsted clinched it. He gave another demonstration as perfect as the one he had already supplied:—The falling stars seen during a great display seem to radiate at any given time from a fixed point; just as parallel lines are foreshortened in perspective to a series of lines radiating from a point. Therefore the tracks of the meteors are parallel. But the point from which the tracks of shooting stars seem to radiate shifts its position from hour to hour with respect to the horizon and the cardinal points. It *moves with the stars* and remains stationary *among them*. Therefore the meteors had been travelling on parallel paths before reaching our atmosphere, and the fiery tracks left by them as they rush through the air form a set of parallel lines differently situated in the air as the earth rotates into different positions, but directed always to the same point on the remote concave of the celestial sphere.

As a piece of pure reasoning, educing from observed facts their full and true significance, nothing can be more perfect than Olmsted's argument; the credit of the achievement should not be lightly assigned to others because many careless professional astronomers of Olmsted's day failed to realise the force of his reasoning, or even to pay any attention to it.

Professor Newton's prediction of the display of November 13-14, 1866, started a new series of inquiries. It has always struck me that that prediction was one of the boldest ever made, and (considering the uncertainty which still hangs over all the problems of meteoric astronomy) one of the most fortunate. We know now that the meteors about which he spoke had been 33¼ years on their course, which carries them far outside the orbit of Uranus, or twenty times our distance from the sun: but in 1866 not even this was known. Professor Newton had a choice of no less than five paths to account for what was then known about the November meteors; and of all the five the true path seemed to him the least probable. Yet he ventured to predict the time of the earth's transit through the meteor-cloud for the morning hours of November 14, 1866, in the Eastern States of America, and he was not wrong by more than about a quarter of a day, the actual display of falling stars occurring in the morning hours of the 14th in Europe, and being over by the time that the eastern seaboard of America had swung round to the side on which the meteors had been falling. American observers were disappointed so far as the expected shower of falling stars was concerned; but American astronomers had every reason to be proud of the success of their calculations.

Science owes to Professor Adams, of Cambridge, the demonstration of the real path of the Leonids, as the November meteors are called (because they seem to radiate from a point in the constellation Leo). By as pretty a piece of mathematical work as has ever been done, he showed that the slight change of position which has been observed during the last few centuries in the crossing-place of the earth and meteors, can only be reconciled with a long oval orbit, 33¼ years in period, which carries the meteors within the disturbing influences of Jupiter, Saturn, and Uranus. Thus the average interval of rather more than 33 years between the great displays of November meteors, is to be explained by the existence of a rich portion—the "gem of the meteor-ring" it has been prettily called—which returns to the neighbourhood of the earth's orbit once in rather more than 33 years, or about thrice in a century. Then came the singular

coincidence by which a comet—discovered in that very year 1866—was found to travel in precisely the same orbit which had thus been assigned to the meteor-system. Already astronomers had suspected the existence of a connection of some sort between comets and meteors. Schiaparelli had shown that if the August meteors follow in the track of the conspicuous comet of 1862, which passed very near the part of her orbit traversed by the earth on Aug. 10, their paths would seem to radiate, as they actually do, from a point in the constellation Perseus. But this might have been a mere coincidence. The agreement between the *paths* of the November meteor-system and Tempel's comet (Comet I., 1866) was a very different matter. If the garrison in a beleaguered city found several cannon-balls falling on the same place and from the same direction, they might guess that these had all come from the same gun—but they could not be certain. If, however, they could determine the exact trajectories of two of these bodies, and found them exactly alike, they could no longer doubt that the same cannon had projected them. Now the exact paths of the November meteor-system and of Tempel's comet have been determined, and are found to be the same (within the narrow limits of errors of observation): no doubt then can exist that the meteors and the comet have had the same origin. The same has since been shown in the case of other comets and other meteor-systems.

It has been customary to repeat Schiaparelli's explanation of this peculiarity,—that a flight of meteoric bodies approaching the solar system after a journey from interstellar space, had chanced to approach so near one of the giant planets as to be diverted from its original course to an elliptical path around the sun, the path always thereafter intersecting the orbit of the disturbing planet. Slight differences in the velocities thus assigned to the meteors would account, said Schiaparelli, for the gradual trailing of many of the meteors behind the main body. This main body would be the comet, the laggards would be the meteoric train (this train being entirely distinct it will be understood from the comet's tail, indeed Tempel's comet had no tail worth mentioning). Schiaparelli's theory was accepted by some astronomers well able to have examined it effectively, without sufficient inquiry. For it is in truth altogether untenable. It can be shown in the first place that a meteor-flight would have to approach a planet much more closely than is at all likely, to have its path changed in the necessary degree. But what is more important, it can be shown that if a meteor-flight did approach a planet thus closely its various members would be very differently affected, and so would be spread into a scattered, widely-ranging flight altogether unlike the existent meteor-streams. There is curious evidence, I may remark in passing, of the carelessness with which Schiaparelli's explanation was accepted. Even astronomers of repute have repeated the statement that those meteors which were most delayed as the flight passed the disturbing planet would lag behind the rest. As a matter of fact those which were least delayed would be the laggards, paradoxical though it may sound to say so. If our earth were checked in her course so as to lose a considerable part of her velocity she would complete her next circuit round the sun in a much shorter period (it would of course be much diminished in extent), *i.e.*, she would return ahead of time: but if she were hastened in her course she would be much longer in completing her next circuit. Nay, if the earth's actual velocity of about 18 miles per second were increased to 25½ miles per second she would never complete another circuit, the range of her path being increased *infinitely*. So with the meteors of Schiaperelli's imagined flights, those most delayed would come back soonest to the place where they had been disturbed, and be ahead of their fellows.

But we need not consider minor flaws in a theory which is in truth entirely untenable.

To replace this unquestionably erroneous theory respecting the common origin of comets and meteors by a true one, would not be easy. The probability is that we have to look back into depths of time so remote that we can hope for no clear view of the processes by which comets and meteors came into existence. I must confess I see little hope in that outlook into interstellar space to which Schiaparelli, Hoek, and others have invited us. It seems to me far more likely that comets and meteors have, for the most part, belonged to our system since it began to be, than that they have been gathered in from that vast unknown region which separates our sun from his fellows. I imagine that comets and meteors are either the "fragments that remain" from the vast mass of nebulous matter or cosmic dust out of which the solar system was gradually formed,—or else they had their origin from the various orbs forming that system when as yet those orbs were in the sunlike state. Only one member of the solar system is now in that state—the sun himself; though the giant planets retain more sunlike characteristics than many imagine. Now the sun does unquestionably eject matter from his interior from time to time, with velocities sufficing to carry such matter for ever away from him: he has been caught in the act. Again, the microscopic examination and the chemical analysis of certain meteors have agreed in showing that these bodies were once aggregations of liquid globules in a hydrogen atmosphere of considerable density—or, as Sorby the mineralogist and Graham the chemist agree in putting the matter these bodies once existed under conditions such as belong only to sunlike bodies. If the sun still gives birth to meteor-flights, one can see no reason why the giant planets, *when they were suns*, should not have done likewise: but, on the contrary, strong reason to believe they would have done so. The comet families of the giant families travel on orbits indicating such an origin, and a flight of meteoric bodies ejected from Uranus millions of years ago, would travel on precisely such an orbit as that of the November meteors. Such seems to me the most reasonable interpretation of the facts, and the one most consonant with all the evidence we have.

RAMBLES WITH A HAMMER.

OVER CHARNWOOD FOREST.

By W. Jerome Harrison, F.G.S.

CHARNWOOD FOREST! How many of my readers know the place? Perhaps there are some who do not even recognise the name. And yet Charnwood occupies thirty square miles in the very heart of England. Look for it in the north-west corner of Leicestershire. There lies the craggy region of old rocks—between Leicester and Loughborough on the east and Ashby-de-la-Zouch on the west, with the Trent running along its northern base—which it is my purpose now to describe. The very name tells us of the nature of the district—"Quern-wood," the wood whence hard stones suitable for the querns or old hand-mills in which corn was ground could be obtained. The hard stone is there still, but the trees are nearly all gone. In Bradgate Park the picturesque, stunted, bossy oaks still flourish, but, as for the rest of the "forest," the fatal Enclosure Act, which came into operation in 1829, has destroyed much of its wildness and

beauty. Attempts have almost everywhere been made to cultivate the poor, thin, stony soil, with the result that, while nature has been spoiled, man has gathered but a scanty reward for his toil.

It is probable that, if our grandfathers could have foreseen that spread of a love for the study of nature among all classes which now exists, together with the great increase in the wealth and population of this country, instead of "enclosing" and "disafforesting" Charnwood, they would have retained it as a national park, have planted it and cared for it, and preserved it as a safe refuge for all that is wild and free in the native fauna and flora of our country. Charnwood is encircled by railways. On the east the Midland main-line runs from Trent to Leicester; and, by getting out at either Sileby (six miles north of Leicester), Barrow-on-Soar (noted for its lower lias limestone), or Loughborough, we shall find ourselves within a moderate walk (two or three miles) of the area in which the old rocks rise to the surface. (Fig. 1.)

Fig. 1.—Map of Charnwood Forest, with the Narborough District. Horizontal shading = slatey rocks; cross shading = igneous rocks; dotted lines = railways.

On the west side of the forest there is the Midland branch line from Leicester to Burton, which actually touches the forest at Bardon Hill station; while the circuit is completed by the little railway lately opened between Coalville (the next station to Bardon) and Loughborough, which skirts the northern and north-western edges.

There are two very pleasant villages in Charnwood where the tourist will find good accommodation, Woodhouse Eaves on the eastern side, and Newtown Linford (beloved of artists) on the south. At the Forest Rock Hotel (in the north-west corner, near Bardon Hill) I have found good quarters, either for the crowd to lunch (and the onslaught of the parties of geologists whom I have led from time to time requires some preparation), or for the solitary knight of the hammer who is belated while puzzling over the intricate rocks of Peldar Tor and High Towers.

The maps required will be 63 N.E. and 63 N.W., published by the Geological Survey; but let the student remember that these maps were made twenty-five years ago, and that we have "learned much since then." As a corrective to the map, no hing can be better than the admirable papers by Messrs. Hill and Bonney.* During the eight years for which I was curator of the Leicester Museum, I devoted some time to the investigation of the Charnwood rocks, and the results of my work are embodied in a "Geology of Leicestershire," which is published by Messrs. J. & T. Spencer, of the Market-place, Leicester. The Leicester Museum contains—or did contain, for I have not visited it lately—a very fine series of Charnwood rocks and minerals; but I was also able to send typical sets to the British Museum (South Kensington), the Jermyn-street Geological Museum, and most of the provincial museums, and I should advise those who mean to visit Charnwood to previously inspect these collections if possible.

To most travellers who study scenery, the Charnwood Hills come as a pleasant surprise. Rising to heights of four hundred or five hundred feet above the surrounding plain, they have all the aspect of a miniature mountain-range, such as one little expects to find planted among the soft clays and sandstones of the Midlands. The highest points are Bardon Hill on the west, 902 ft. above sea-level; and Beacon Hill on the east, 840 ft.

Nor is the surprise of the geologist abated when he walks over the ground, and minutely examines the rocks in the quarries and on the hill-sides. In the first place, there are coarse slates, and finer workable slates, with volcanic ashes and agglomerates of a most remarkable nature and appearance. Apparently breaking through these sedimentary rocks are great bosses of syenite and granite, yet the junction between the two sets of rocks—the stratified or slaty, and the unstratified or syenitic—is hardly anywhere visible, so that it has been argued by a certain school of geologists that the latter rock (the syenite) is really only the same thing as the coarse slate, but that it is slate which has been so greatly altered by heat and other agencies (metamorphosed) that it has become a crystalline rock. By careful search I have, however, been able to find sections which entirely disprove this view, and which show that the syenites are truly igneous rocks which have come up from below in a melted state, and have forced themselves through the slaty beds. From this it follows that the slates are the *older* of the two. But what is the age of the Charnwood slates? That is a very difficult question, and one which has hitherto been little more than a matter of conjecture. Quite recently, however, discoveries have been made, not in the Forest region itself, but at some little distance from it, which throw much light upon the question.

When Professor Sedgwick examined Charnwood in 1833, he considered the strata to be of "Cambrian" age, and he was followed in this by Professor Hull (of the Geological Survey), who mapped the country in 1860.

From the remarkable similarity of the rocks to the "Green Slates and Porphyries" of the Lake district, Professor Bonney was at one time led to assign the Charnwood beds to the Lower Silurian period, but he has since acknowledged that the discovery—by Dr. Hicks—of a great series

* "Quarterly Journal of the Geological Society," vol. 33, p. 754; vol. 34, p. 199; and vol. 36, p. 337.

of rocks of volcanic origin underlying all the other rocks of Wales, and therefore of *Pre-Cambrian* age, has led him to consider that the Charnwood rocks, too, may be of this enormous antiquity. From the study of the Silurian rocks of the Lake district, I, too, once believed them to be identical with our Leicestershire strata, but I now feel certain that the latter are of Pre-Cambrian age. Is it possible that any mistake can have been made in mapping the strata in Cumberland and Westmorland, and that they, also, are of this high antiquity?

(To be continued.)

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

THE FOURTH EVENING *(continued)*.

"AFTER Mercury comes the sun; but there is no possibility of peopling it, nor no room left for a wherefore. By the earth which is inhabited, we judge that other bodies of the same nature may be likewise inhabited: but the sun is a body not like the earth, or any of the planets; the sun is the source or fountain of light; which, tho' it is sent from one planet to another, and receives several alterations by the way, yet all originally proceeds from the sun: he draws from himself that precious substance which he emits from all sides, and which reflects when it meets with a solid body, and spreads from one planet to another those long and vast trains of light which cross, strike thro', and intermingle in a thousand different fashions, and make (if I may so say) the richest tissues in the world.

"The sun likewise is placed in the center, from whence, with most convenience, he may equally distribute, and animate by his heat. It is then a particular body, but what sort of body, has often puzzled better heads than mine. It was thought formerly a body of pure fire; and that opinion passed current till the beginning of this age: when they perceiv'd several spots on its surface. A little after they had discover'd new planets (of which hereafter), which some say were those spots; for those planets moving round the sun, when they turn'd their dark half to us, must necessarily hide part of it: and had not the learned, with these pretended planets, made their court before to most of the princes in Europe, giving the name of this prince to one, and of that prince to another planet, I believe they would have quarrell'd who should be master of these spots, that they might have nam'd them as they pleas'd."*

"'Twas but t'other day," says the lady, "you were describing the moon, and call'd several places by the names of the most famous astronomers. I was pleas'd with the fancy: for since the princes have seiz'd on the earth, 'tis fit the philosophers (who are as proud as the best of 'em) should reserve the heavens for themselves without any competitors."

"Oh! trouble not yourself," said I, "the philosophers make the best advantage of their territories; and if they part with the least star, 'tis on very good terms: but the spots on the sun are fallen to nothing. 'Tis now discover'd that they are not planets, but clouds, streams, or dross, which rise upon the sun, sometimes in a great quantity, sometimes in a less; sometimes they are dark, sometimes clear; sometimes they continue a great while, and sometimes they disappear as long.

"It seems the sun is a liquid matter; some think, of melted gold (!), which boils over as it were continually and by the force of its motion calls the scum or dross on its surface, where it is consum'd, and others arise. Imagine then what strange bodies these are, when some of them are as big as the earth. What a vast quantity must there be of this melted gold! and what must be the extent of this great sea of light and fire which they call the sun?

"Others say, the sun appears thro' their telescopes full of mountains, which vomit fire continually, and are joined together like millions of Etna's. Yet there are those that say, these burning mountains are pure vision, caus'd by a fault in the spectacles; but what shall we trust, if we must distrust our telescopes, to which we owe the knowledge of so many new objects? But let the sun be what it will, it cannot be at all proper for habitation; and what pity that is! for how pleasant would it be! You might then be at the center of the universe, where you would see all the planets turn regularly about you; but now we know nothing but extravagant fancies, because we do not stand in the proper place. There is but one place in the world, where the study or knowledge of the stars is easily obtain'd, and what pity 'tis there is nobody there!"

"You forget yourself, sure," says she; "were you in the sun you would see nothing, neither planets nor fixed stars: doth not the sun efface all? So that could there be any inhabitants there, they might justly think themselves the only people in Nature."

"I own," said I, "my mistake: I was thinking of the situation of the sun, and not of the effect of its light: I thank you for your correction; but must take the boldness to tell you, that you are in an error as well as myself: for were there inhabitants in the sun, they would not see at all; either they could not bear the strength of its light, or for want of a due distance, they could not receive it; so that things well consider'd, all the people there must be stark blind, which is another reason why the sun cannot be inhabited. But let us pursue our voyage."

(To be continued.)

* They called them the Bourbonian stars.—R. P.

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

IN holiday times it is well to make experiments and observations which are sure to interest the young folks. One of the best that can be suggested is to form a so-called lead-tree, portions of which make very pretty objects for the microscope. The proceeding is very easy. Get a clear, round, glass bottle, holding six ounces. Take two drachms of acetate of lead, and dissolve in six ounces of distilled water. If the water is pure, it will dissolve the salt without milkiness; but it is seldom pure enough for this. The solution, if not quite clear, should be allowed to stand until a deposit settles to the bottom, and the clear part may then be poured off for use. Take a thin strip of zinc, about a quarter of an inch wide, which should be made bright by rubbing with a little sand or Flanders brick-dust, or by wiping with a rag moistened with dilute hydrochloric acid. Make one end of the zinc sharp, and force it into a cork that fits the bottle. The strip of zinc should be long enough for one inch of the metal to be immersed in the fluid. The acetic acid of the lead salt immediately attacks the zinc, forming a soluble acetate of that metal. The lead is precipitated in a beautiful feathery form. As soon as an elegant little tuft is seen, withdraw the cork, and scrape off the lead on to a piece of blotting-paper. As soon as it is dry, select a

pretty piece to view with an inch or lower power under the microscope. When a piece worth preserving is obtained, mount it in Canada balsam, which will keep it from tarnishing.

The cork with the zinc attached to it should be quickly replaced in the bottle, which must be left quite free from shaking for a day or two. It is very interesting to watch the gradual formation of the lead tree with a magnifying glass. The tree will last for some time if not disturbed, and when it falls to pieces the smaller crystalline leaves should be placed under the microscope. If melted lead is slowly cooled, it forms octohedral crystals. In the experiment just described the forms are arborescent, like the frost figures with which a cold winter adorns our window-panes. The exact character of the lead tree figures varies according to the strength of the solution. The proportions mentioned give the prettiest effect—that of large metallic leaves composed of smaller feathery deposits. All the soluble salts of lead are extremely poisonous, including the acetate. It must therefore be used with care, and not placed where inquisitive children may be tempted to taste it.

A still more beautiful experiment may be made with the formation of a silver tree. This metal crystallises in arborescent forms as native silver, and sometimes in cubes or octohedra. For our present purpose, get a solution of five grains of crystallised nitrate of silver in one dram of distilled water. If the water is quite free from chlorides and certain other impurities, the solution will be clear, and will keep for any length of time in a *stoppered* bottle. Neither cork nor any other organic matter should be allowed to come into contact with it. It is highly poisonous. Melted and cast in sticks, nitrate of silver is the lunar caustic of the doctors. It is also the active ingredient in marking-inks, and stains the skin black, besides destroying it, unless it is very dilute. A slate-blue man is still occasionally seen, bearing for life that sad tint, the evidence of having been doctored with this salt.

To obtain a silver tree, take up a drop of the solution on a glass rod, and transfer it to the centre of an ordinary glass slide, placed on the stage of the microscope, which for this purpose should be *horizontal*, to prevent the drop running. Focus the drop with an inch power, and then put in the middle of it a piece of copper the size of a small pin's head, which can be cut from a bit of bell-wire. Instantly the nitric acid will attack the copper, setting free the silver, which forms numerous branches, something like a Selaginella, and exquisitely brilliant in reflected light. A dram of the solution will enable the experiment to be repeated scores of times, and there are few that are more striking. A fresh and bright particle of copper should be used on each occasion. I do not give a figure of the silver tree, because its beauty depends very much upon the fine colour of the pure metal, which no engraving could reproduce. When quite dry the piece of copper should be removed, and the tree can then be mounted in Canada balsam; but, unless the covering-glass is very gently superposed, the crystals are scattered and the beauty lost.

THE GAMBLING SPIRIT IN AMERICA.

By Richard A. Proctor.

At Monte Carlo the gambling spirit has shown itself during the past few years in such a way as to startle even those who have not been accustomed to regard gambling with special horror. France, which encourages a national system of gambling; and Britain, whose betting ways have long put her among the very foremost of the gambling races, look on with pain and sorrow at a system of gambling which seems dwarf-like compared with the system of lotteries in France and British betting on races. So easy is it to see the mote in another's eye while a beam in our own is overlooked! But, much as all European nations are given to gambling in various forms, Americans seem to have gone altogether beyond them. In America boys of ten or twelve bet as resolutely as bookmakers at a British race. Everything seems to afford fit subject for wagering in America, insomuch that betting expressions have become part of the language. A man can hardly express agreement with another in America save by saying, "You bet," or "you may go your pile," or "bet your bottom dollar," or the like, "on that." The progress of the Presidential election brought out the betting element in a marked way throughout the length and breadth of America. In every State of the Union, north and south, east and west, betting men—by which one may be said to mean nine out of ten of all the men and boys in America—backed their favourite candidate at the current odds. These were published in the papers as systematically, though not as exactly, as the betting on races in England. A fabulous amount of money changed hands over the results of the election, and preposterous though it may seem, it is nevertheless true, that a large part of the energy with which the results of the New York election were canvassed had its origin simply in the anxieties of betting men to get a good chance of hedging.

I can imagine no worse sign in a community than the general prevalence of the gambling spirit. It is so rife in my own country that I am making no attack specially on America, or any vaunt respecting England, in saying this. The gambling spirit is evidence of an immoral, unprincipled nature. Those who find themselves possessed by it should be as anxious about so evil a symptom as a man would be who should find himself spitting blood or giving other evidence of a disease affecting his whole physical nature. A nation in which the gambling spirit is seen to be prevalent is in a dangerous way, though it may well be that the difference between one nation and another in this respect is only apparent, and due to the circumstance that in one nation gambling folk take a more prominent position than in another. Just as one who had travelled much in America might be disposed—if in England he belonged to the classes which take no part in trade—to imagine that a much larger portion of the American population are engaged in business than in England, so may the opinion be quite as mistaken that betting is very much more prevalent among Americans than among ourselves. We know that business men and tradesmen take a better position and mix more in society in America than at home, so that they are much oftener met. May it not well be that the real fault in America (for serious fault there must be somewhere) in regard to betting lies not in the much greater prevalence of betting-folk, but in the circumstance that they are suffered to intrude in America into circles whence in England they are excluded (unless they happen to be titled or wealthy persons, when they are too easily admitted into the company of the better-principled portion of the community). American political life is not only open to immoral and unprincipled men, but, as has been only too strikingly shown of late years, honest men are withdrawing themselves more and more carefully from it. Among the various office-holders and dependents on office-holders in America, an immense proportion are of just the class from which the betting community is formed. Nay, political life in America is itself a lottery, and a man must be very strongly imbued with the gambling spirit to become a politician in the

United States. After entering on political life in America, a man's best chance of becoming rich lies in the judicious application of his political influence to furthering, at a price, such financial schemes as come in his way. Politicians in America see nothing wrong in this employment of their influence. I have no doubt Mr. Blaine was quite in earnest in saying that he had no reason to be ashamed of anything which came out respecting his correspondence with Mr. Fisher, though an English statesman (if one could conceive anything of the kind happening in England) could never have raised his head again after such a disclosure. Nor do most other American politicians appear to have been much surprised or ashamed at anything which appeared in those Mulligan letters.

It seems tolerably manifest that we can make no comparison between American and English morality in matters political, until we have an opportunity of observing how matters proceed when the best classes in America take to politics, and thrust to their deserved position in the background the adventurers who now disgrace the nation. It may well be that then the gambling spirit will be found to be no more widely prevalent in America than in our own country. At present, it unquestionably is much more obtrusive.—*Newcastle Weekly Chronicle.*

AN INTERESTING FAMILY.

By David Houston, F.L.S.

NOT at all uncommonly in the still, clear water of open drains or sheltered ditches may be found a floating, elongated, ragged, or sac-like net of green, buoyed one end uppermost by a mesh-entangled bubble of gas evolved by the living moieties of the singularly complex organism. The net, as will be readily observed, varies considerably in size; but three or four inches long and one to one and a-half inches deep may be taken as a typical full-growth measurement.

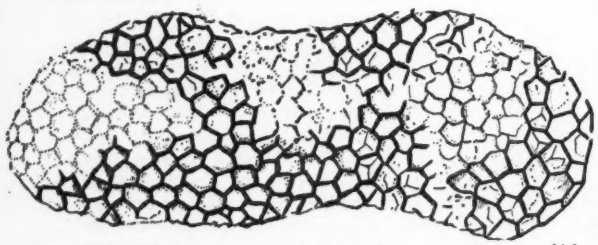


Fig. 1.—"Water-Net" (*Hydrodictyon*), natural size. (After Cooke.

This peculiar vegetable growth (Fig. 1) is an algal family of very many individuals, each individual simply consisting of an elongated or oblong cylindrical rod (Fig 2) about a

Fig. 2.—A single cell or individual (very much enlarged) from the Water-net colony.

line or so in length, brightened in the season of active growth with a light or vivid green colour. Structurally, each rod is made up of a mass of protoplasm enclosed in an exceedingly thin cellulose wall forming a single histological element or cell. The green pigment or chlorophyll is confined to the protoplasm, and to that part of the protoplasm that lies immediately within the cell-wall, leaving a slender, colourless portion in the central region of the tiny plant.

Instead of living a life of comparative isolation, like a great many unicellular and other simple algæ, these interesting organisms elect to form special groups, or families, and share together the seasonal ups and downs of quiet vegetable life in the drainage-water of an unpolluted ditch. In the formation of a colony, either end of any individual cell meets one of the ends of each of two other cells, and, as a geometrical result, meshes averaging about one-sixth of an inch are constructed, each space being bounded by

Fig. 3.—One of the "Meshes" of Water-Net (magnified). After Cohn.

five cells (Fig. 3). The presence of a gelatinous substance adhering to the outside of the cell walls—and, perhaps, arising from a slow disintegration of the material of the wall itself—is of very common occurrence among members of the class of algæ. It is by virtue of the existence of this jelly-like matter that the individuals of this family can remain closely, although not organically, attached, and form a net-like floating community, or sisterhood.

The plant, or rather the assemblage of plants, is known "vulgarly" as the "water-net," while its scientific, generic name of Hydrodictyon (Gr., *hudor*, water; *diktuon*, a fishing-net) expresses exactly the same idea as the common or simple one. There is—so far as is at present known—only one species of Hydrodictyon (*Hydrodictyon utriculatum*). It is distributed throughout the pure fresh waters of Europe and North America, never, it seems, attaining in any locality a size beyond a length of twelve inches, with meshes of a third of an inch in diameter. Like all chlorophyll-bearing plants, the water-net is able to manufacture starch under the influence of solar light and heat out of the chemical elements of carbonic acid gas and water; but, as there is more oxygen proportionately present in the dioxide of carbon and monoxide of hydrogen than in the molecules of starch, a considerable quantity of pure oxygen is liberated during the hours of sunshine, and it is from this source that the gaseous body above referred to is kept in existence day by day throughout the plant's active period of vegetative growth. The manufactured starch may be discovered in the form of minute grains lying in the peripheral or greenish region of the protoplasm; but their presence can be rendered clearly visible by treatment with solution of iodine, under the action of which the grains will assume a dark blue colouration. It is, of course, from this starch and from protinaceous substances formed through the vital activity of the plant, together with certain ever-essential inorganic salts obtained from the drainage water, that the protoplasm derives its constructive material or food, and out of which it is able to build up new protoplasmic substance, enabling it to increase itself in size, and, in due time, to attain an adult condition.

After a course of purely vegetative growth, during which all the energies of the plant are directed to its

nutrition and general self-interest, the different individuals in the net-like colony enter into a reproductive stage, whereby the preservation of the race will be secured after the death of the now-existing family. The changes about to take place within the cell at this period are preceded by a loss of the bright green colour so characteristic of the organism, the starch also disappears, while a vast number of little clear specks arise throughout the now quickly modifying cell-contents. In a short time the protoplasmic mass is broken up into a very great number (7,000 to 20,000) of roundish grains (*gonidia*), which for a space of half-an-hour or so move with a tremulous motion within

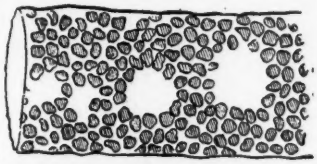


Fig. 4.—Portion of a cell of Water-net (magnified 400 times), showing the formation of *Micro-gonidia*. (Cohn.)

the cell (Fig. 4). When they come to rest, they arrange themselves by force of heredity, after the usual plan of cell-grouping observable in the adult colony; then when the old wall of the mother cell is finally absorbed, or otherwise destroyed, a brood of cohering sister Hydrodictyon plantlets escape to lead an independent existence in the surrounding water. The individuals rapidly elongate, and, still continuing to remain attached by their ends, the group soon assumes the appearance of a miniature water-net. After this, cell enlargement proceeds most actively; and, at the end of three or four weeks, the colony will have attained full size and maturity.

Fig. 5.—Single *Macro-gonidia* (magnified 600 times).

There is another, but less usual, way by which the Hydrodictyon plant multiplies itself. Each individual cell, instead of breaking up its contents into the comparatively large gonidia (hence known as *macro-gonidia*), above referred to, resolves its protoplasmic mass into an enormous

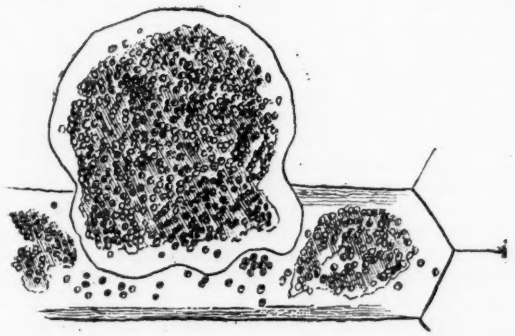


Fig. 6.—Portion of cell (magnified 300 times), showing escaping *Micro-gonidia*. (Cohn.)

number (30,000 to 100,000) of inconceivably small gonidia (*micro-gonidia*), which, instead of cohering among themselves, remain perfectly free from one another and eventually escape (Fig. 6), as unwalled and ciliate spores (Fig. 7), by the rupture of the old mother-wall. By the agency of their cilia they are able to move hither and thither throughout the water and mix with similar spores, set free from the cells of other water-nets. It would seem that these motile bodies (generally described as *zoospores*) are of sexual phy-

Fig. 7.—Single *Micro-gonidia* (magnified 600 times).

siological importance, and that they conjugate with one another during their brief period of activity. The conditions under which the act of conjugation is effected are, of course, entirely against the chances of self-fertilisation, and thus the well-known benefits of a "cross" are fully secured to the next succeeding algal generation. Immediately upon conjugation being completed the dual mass draws in its cilia, rounds itself off, forms for itself a resisting cell-wall, and falls to the mud at the bottom of the ditch, within or on the surface of which it lies in a still or dormant condition for a period of three or four months. On the approach of spring vital activity is again resumed, and for the next few months growth and development are strictly confined to an enlargement of the cell. When the cell has attained its maximum size, its contained protoplasm breaks up into three, four, or five large ovate zoospores that generally escape and move freely through the surrounding water. But they soon become motionless, and develop into single, many-sided cells, from the angles of which long, horn-like processes invariably grow. Finally, the contents of each polyhedron resolves itself into a group of two or three hundred gonidia enclosed in an extremely delicate sac that protrudes itself from the burst side of the containing cell, and these, after about half-an-hour's tremulous motion, come to rest and arrange themselves into a miniature net-like structure which, eventually bursting the womb, escape, and, still remaining attached to one another, gradually increase in size and grow into a mature Hydrodictyon, only differing from a non-sexually produced "net" in having a fewer number of cells. But such cells or individuals as these that are the resulting offspring of a sexual act have had their vital energies as it were renewed; their constitutional vigour and reproductive powers have been considerably increased, and they have acquired a potential of growth and multiplication that will enable them to run through several non-sexual generations before they have exhausted the present stock of available hereditary energy.

Tabulating, then, by way of a summary, the entire possible life-history of Hydrodictyon, or water-net, we have:—

Non-sexual generation multiplying by the formation of macro-gonidia repeated for many generations.
Sexual generation multiplying by formation of micro-gonidia or zoospores.
Conjugation.
Resting spore.
Renewal of growth and enlargement of cell.
Conversion of entire cell-contents into 3—5 large zoospores.
Development of these into "polyhedra."
Formation of numerous gonidia within the polyhedra.
Arrangement of gonidia into an ordinary net colony.
Non-sexual generation multiplying by macro-gonidia repeated for many generations.

We are asked to state that Mr. Higgins's book, "Museums of Natural History," which was reviewed on p. 488, is published by D. Marples & Co., of Liverpool.

OUR TWO BRAINS.

By Richard A. Proctor.

(*Continued from p. 479.*)

THE case of dual consciousness now to be considered is a remarkable one. The original narrative of M. Azam is somewhat prolix,—the following account is from an article by Mr. H. J. Slack, in which the account has been skilfully abridged.

The subject of the disorder, Felida X, was born in Bordeaux in 1843. Until the age of thirteen she differed in no respect from other girls. But about that time symptoms of hysterical disorder presented themselves, and although she was free from lung-disease, she was troubled with frequent spitting of blood. After this had continued about a year, she for the first time manifested the phenomena of double consciousness. Sharp pains attacked both temples, and in a few moments she became unconscious. This lasted ten minutes, after which she opened her eyes, and entered into what M. Azam calls her second state, in which she remained for an hour or two, after which the pains and unconsciousness came on again, and she returned to her ordinary condition. At intervals of about five or six days, such attacks were repeated; and her relations noticed that her character and conduct during her abnormal state were changed. Finding also that in her usual condition she remembered nothing which had passed when she was in the other state, they thought she was becoming idiotic; and presently called in M. Azam, who was connected with a lunatic asylum. Fortunately, he was not so enthusiastic a student of mental aberration as to recognise a case for the lunatic asylum in every instance of phenomenal mental action. He found Felida intelligent, but melancholy, morose, and taciturn, very industrious, and with a strong will. She was very anxious about her bodily health. At this time the mental changes occurred more frequently than before. Nearly every day, as she sat with her work on her knees, a violent pain shot suddenly through her temples, her head dropped upon her breast, her arms fell by her sides, and she passed into a sort of sleep, from which neither noises, pinches, nor pricks could awaken her. This condition lasted now only two or three minutes. "She woke up in quite another state, smiling gaily, speaking briskly, and trilling (*fredonnant*) over her work, which she recommenced at the point where she left it. She would get up, walk actively, and scarcely complained of any of the pains she had suffered from so severely a few minutes before. She busied herself about the house, paid calls, and behaved like a healthy young girl of her age. In this state she remembered perfectly all that had happened in her two conditions." (In this respect her case is distinct from both the former, and is quite exceptional. In fact, the inclusion of the consciousness of both conditions during the continuance of one condition only, renders her case not strictly speaking one of double consciousness, the two conditions not being perfectly distinct from each other.) "In this second life, as in the other, her moral and intellectual faculties, though different, were incontestably sound. After a time (which in 1858 lasted three or four hours), her gaiety disappeared, the torpor suddenly ensued, and in two or three minutes she opened her eyes and re-entered her ordinary life, resuming any work she was engaged in just where she left off. In this state she bemoaned her condition, and was quite unconscious of what had passed in the previous state. If asked to continue a ballad she had been singing, she knew nothing about it, and, if she had received a visitor, she believed she had seen no one. The forgetfulness extended to everything which happened during her second state, and not to any ideas or information acquired before her illness." Thus her early life was held in remembrance during both her conditions, her consciousness in these two conditions being in this respect single; in her second or less usual condition she remembered also all the events of her life, including what had passed since these seizures began; and it was only in her more usual condition that a portion of her life was lost to her—that, namely, which had passed during her second condition. In 1858 a new phenomenon was noticed as occasionally occurring—she would sometimes wake from her second condition in a fit of terror, recognising no one but her husband. The terror did not last long, however; and during sixteen years of her married life her husband only noticed this terror on thirty occasions.

A painful circumstance preceding her marriage somewhat forcibly exhibited the distinction between her two states of consciousness. Rigid in morality during her usual condition, she was shocked by the insults of a brutal neighbour, who told her of a confession made to M. Azam during her second condition, and accused her of shamming innocence. The attack—unfortunately but too well founded as far as facts were concerned—brought on violent convulsions, which required medical attendance during two or three hours. It is important to notice the difference thus indicated between the character of the personalities corresponding to her two conditions. "Her moral faculties," says M. Azam, "were incontestably sound in her second life, though different,"—by which, be it understood, he means simply that her sense of right and wrong was just during her second condition, not, of course, that her conduct was irreproachable. She was in this condition, as in the other, altogether responsible for her actions. But her power of self-control, or rather perhaps the relative power of her will as compared with tendencies to wrong-doing, was manifestly weaker during her second condition. In fact, in one condition she was oppressed and saddened by pain and anxiety, whereas in the other she was almost free from pain, gay, light-hearted, and hopeful. Now I cannot altogether agree with Mr. Slack's remark, that if, during her second state, "she had committed a robbery or an assassination, no moral responsibility could have been assumed to rest upon her with any certainty, by any one acquainted with her history," for her moral faculties in her second condition being incontestably sound, she was clearly responsible for her actions while in that condition. But certainly, the question of punishment for such an offence would be not a little complicated by her twofold personality. To the woman in her ordinary condition, remembering nothing of the crime committed (on the supposition we are dealing with), in her abnormal condition, punishment for that crime would certainly seem unjust, seeing that her liability to enter into that condition had not in any degree depended on her own will. The drunkard who, waking in the morning with no recollection of the events of the past night, finds himself in gaol for some crime committed during that time, although he may think the punishment he has to endure severe measure for a crime of which in his ordinary condition he is incapable, knows at least that he is responsible for placing himself under that influence which made the crime possible. Supposing even he had not had sufficient experience of his own character when under the influence of liquor, to have reason to fear he might be guilty of the offence, he yet perceives that to make intoxication under any circumstances an excuse for crime would be most dangerous to the community, and that he suffers punishment justly. But the case of dual consciousness is altogether different, and certainly where responsibility exists under both

conditions, while yet impulse and the restraining power of will are differently related in one and the other condition, the problem of satisfying justice is a most perplexing one. Here are in effect two different persons residing in one body, and it is impossible to punish one without punishing the other also. Supposing justice waited until the abnormal condition was resumed, then the offender would probably recognise the justice of punishment; but if the effects of the punishment continued until the usual condition returned, a person would suffer who was conscious of no crime. If the offence were murder, and if capital punishment were inflicted, the ordinary individuality, innocent entirely of murder, would be extinguished along with the first, a manifest injustice. As Huxley says of a similar case, "the problem of responsibility is here as complicated as that of the prince-bishop, who swore as a prince and not as a bishop. 'But, your highness, if the prince is damned, what will become of the bishop?' said the peasant."*

(To be continued.)

CHAPTERS ON MODERN DOMESTIC ECONOMY.

VIII.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

A MODEL outhouse, designed to work in conjunction with the dry-earth or ash system, or a combination of both, ought to be constructed in such a way as to provide an arrangement which shall be wholesome and economical. Its mechanical parts should embrace:—(i) An apparatus for separating the ashes from the cinders in such a manner that the former shall find its way into a hopper-box, from which it can be discharged in suitable quantities over the fæcal matters by means of a crank and pull-handle, whilst the cinders are entirely and automatically thrown into a compartment, from whence they can be readily removed for future use. (ii) The waste soil ought to be received into a pail of such a shape and size, and so placed, that the earth or ashes shall completely cover its contents; an intervening mechanical partition, made to screen the soil, is desirable, though not indispensable. Of course, the pail ought to be capable of being easily removed; or, if a vault be used, it should admit of being thoroughly cleared with the utmost facility. (iii) A separate receptacle or bin ought to adjoin the outhouse for the reception of house-sweepings, garbage, &c.

Experimental researches have shown that the water system of sewage is not only defective, because of its baneful influences over our water-supply and the general health of the public, but that it is wasteful, almost to an alarming degree. The soil becomes impoverished of those ingredients which nature seeks to restore through an equalised balance of plant and animal life, but it is in a great measure thwarted by this intervention of man. Most of the valuable constituents of the soil are practically lost; they only help to induce contamination of the atmosphere, instead of re-taking their part in the enrichment of the earth. When the process of mechanical separation is applied, the sludge that remains behind is almost valueless, because it is deprived of many essential components which cannot be replaced except by artificial means. Fortunately, there are chemical processes which deal adequately with sewage, and these ought always to be called into use where they can be conveniently applied. In former issues we drew the attention of our readers to the A B C process of the Native Guano Company; we are glad to be able to record that their efforts to utilise sewage have been duly recognised and rewarded by the Councils of both the "Fisheries" and the "Health" Exhibitions with the highest possible awards.

What we desire to point out now, however, is, the way in which the waste matters of a household can be best converted into valuable material, in a thoroughly wholesome way. Those who possess moderately large-sized gardens would do well to adopt the earth and ash systems of treatment without delay, and without applying to the necessarily tardy local authorities for any assistance. They will find, by the use of Moule's "Patent Earth System" or Morrell's "Patent Self-acting Cinder-sifting Ash-closet System," that they will be able to secure an adequate supply of mould of the very best manurial quality for their own grounds, and at the same time completely cut themselves off from foul sewers, with their innumerable disadvantages, necessitating costly trapped drains with inspection-pipes and orifices, which, if we may be allowed to speak figuratively, have a kind of predisposition to get out of order periodically. Moreover, they can secure all these advantages at but a moderate outlay for new out-houses and special earth-closets. In our descriptive notes, to follow hereafter, we shall give a few specific examples of the best forms of apparatus already introduced.

The dry-earth system is undoubtedly the best from a sanitary aspect. Earth of a loamy nature, perfectly dry (yet not so dry as to fly into a dust when used), and finely sifted, ought to be employed; if these precautions are taken, not only will it act as a perfect deodoriser and disinfectant, but, in combining with the waste soil, form a particularly rich manure, which can be used to the greatest advantage in the garden, and when produced in excess, can always be sold for a good price. Sand should never be used, as it is neither absorbent, deodorising, nor disinfectant. We have no doubt that if a large body of householders in each suburb of this city were to decide to use the earth system, the local authorities would very soon commence to send their collecting carts round frequently and regularly; or, if they do not do so, they would not be at a loss to find capitalists to collect and to pay for house refuse of such good quality.

It may be urged by some persons that finely-sifted and dried loam cannot be readily procured, but we have no hesitation in stating that the authorities or other collectors would find it worth their while to supply the required earth in place of the valuable manure. Then, there is another very weighty argument in its favour. Let us suppose that suitable earth cannot really be obtained; an unfailing supply of ashes are to be found in every household, and will, under Morrell's ash-system, be found amply adequate to the requirements of the case. By that process the ashes are carefully separated from the cinders; the former is substituted, either wholly or in part, for the earth, whilst the latter, which are undesirable in a manure, are stored for reburning. There is no waste, whilst the refuse is doubly utilised in this application of the one to the other; the sum total being an actual diminution in quantity of house refuse, with the manufacture of a valuable and saleable product.

Ashes mixed with the manure have been repeatedly

* Should any doubt whether these conditions of dual existence are a reality (a doubt, however, which the next case dealt with in the text should remove), we would remind them that a similar difficulty unmistakably existed in the case of Eng and Chang, the Siamese twins. It would have been almost impossible to inflict any punishment on one by which the other would not have suffered, and capital punishment inflicted on one would have involved the death of the other.

condemned by agriculturists; but we think that most of such observations are founded upon an imperfect knowledge of the process, and its slovenly application in experiment. Thus, the ashes must be deprived of their associated particles of cinders, for the latter favour decomposition and are injurious to plants in a manure. The analyses of various samples of coal-ash, on the contrary, show that they are of great value in the enrichment of the soil. Dr. Stockhardt, in his address on the "Chemistry of Agriculture," says:—"Notwithstanding that this ash is frequently so little valued as to be thrown away, it deserves to be made use of in agriculture, in the first place because it contains, besides small quantities of alkalies, *lime* and *sulphuric acid* (gypsum), consequently direct sustenance for plants; in the second place, because from the same circumstance, as also from the clay it contains, it has the power to deprive putrefying substances of their odour, and to fix their ammonia, so that it cannot evaporate." This is practically substantiated by the evidence given some time ago in the *Quarterly Review*, as follows:—

A correspondent of the *Paris Journal of Agriculture*, seeing the amount of ashes thrown away annually, and considering that Sir Humphrey Davy and other chemists have found by analysis that ashes contain many substances which contribute to vegetable life—such as sulphate of potash and lime, alumina, and silica—has made some interesting experiments. In the autumn, he filled three flower-pots with coal-ashes, without any admixture with any other substance; in the one pot he sowed wheat, in the other oats, and in the third strawberry-seeds. The pots were then placed in a garden, and left to themselves. In the month of March the plants were in a very thriving condition; and in April were luxuriant. The wheat and oats ripened perfectly, the grains being large and heavy, and the straw, in the case of the wheat fifty-five inches, and that of the oats forty-three inches high. The strawberry-plants continued to flourish until October, when it was necessary to transplant them, and, after being planted out on the open ground, they succeeded so well that the writer says they surpassed all other seedlings.

Thus we find that there are methods open to us whereby, with a decreased aggregate expenditure, we are enabled to free our houses from their greatest source of evil, the sewers, and, in doing so prevent the pollution of rivers and other water-supplies, upon which the health of the community so largely depends; and the best of all this is, that it can be accomplished by the *utilisation* of refuse products. In the instance of new houses, not already provided with the water-closet system, we would strongly recommend the builder to adopt the provisions we have described, and thus to save himself a heavy outlay, and at the same time help to commute the sufferings of the people from an already too-polluted condition of things.

"The Fern Portfolio" Volume.—The Society for Promoting Christian Knowledge will publish, as a Christmas-book, the completed volume of Mr. Francis George Heath's "Fern Portfolio," which will include upwards of sixty figures, life size, coloured from nature, and comprising all the species of ferns found in the British Islands.

The Anti-Vivisectionists.—It is hardly necessary for us to say that the anti-vivisectionists and anti-vaccinationists do not stop at equivocation, or even at deliberate lying, in their desire to influence public opinion. Two of them have, we are glad to see, been brought to book. One Ernst Weber has recently been sentenced to eight weeks' imprisonment for having, in the journal of which he is editor, published, under the heading "Vivisection of a Man," a statement that about eight years ago a Jewish physician had made a post-mortem examination of a man while only apparently dead, and therefore had performed vivisection on him. Dr. Pelz, who had performed the post-mortem in question, summoned him before a court of justice with the above result. A clergyman of Münster also, who was the author of the article, was sentenced to six weeks' imprisonment.—*Medical Press and Circular.*

FIRST STAR LESSONS.

By Richard A. Proctor.

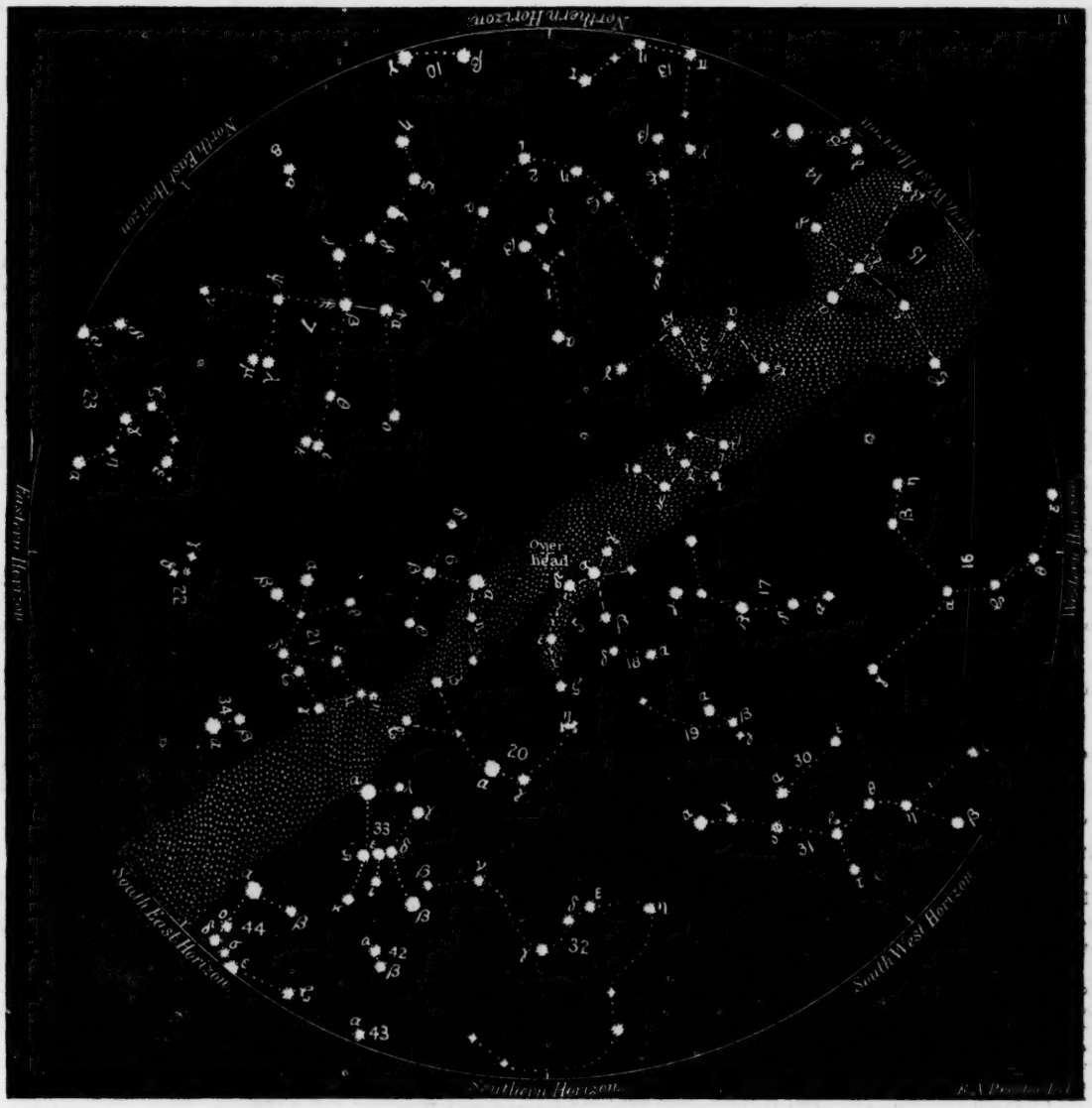
THE constellations included in the set of maps are numbered throughout as follows:—

1. *Ursa Minor*, the *Little Bear* (*α*, the *Pole Star*).
2. *Draco*, the *Dragon* (*α*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*α*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*α*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*α*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*α*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*α*, *Vega*).
15. *Cygnus*, the *Swan* (*α*, *Arided*; *β*, *Albireo*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*α*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*α*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*α*, *Regulus*).
24. *Virgo*, the *Virgin* (*α*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*α*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*α*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*α*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*α*, *Alphard*).
36. *Crater*, the *Cup* (*α*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*α*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*α*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*α*, *Sirius*).
45. *Argo*, the *Ship*.

THE RACERS OF THE SEA.

WHETHER or not there shall be such rapid strides in the improvement of navigation on the ocean in the next three hundred years as there has been since 1543, when Captain Blasco de Garry, of the Spanish navy, tried a vessel of 209 tons at Barcelona, Spain, the motive-power of which consisted of a cauldron of boiling water and a movable wheel suspended on each side of the vessel, remains to be answered by future generations. It does, however, seem that it can hardly be possible that as great improvements can be made in the next sixty-five years as there have been since the rudely-constructed American steamship Savannah made the passage from Savannah to Liverpool, in 1819, in twenty-six days with the aid of sails and steam. Since the Guion Steamship Line put under its flag the palatial and fleet steamship Arizona, which was the first of the seven-days ships to be run in the New York and Liverpool trade, those interested in the transatlantic steamship traffic have put forth their energies to exceed the first efforts by building a little larger and faster vessels than their neighbours. This interest is not alone confined to builders and owners, but extends to the difference in models and tonnage of these fast vessels. Many inquiries are made as to the quickest trips across the Atlantic; the fastest average trips; the greatest distance in twenty-four hours, and so forth.

Since the Arizona made a revolution in ocean speed, there have been the following large and fast vessels built for the transatlantic trade:—The Alaska and Oregon for the Guion Line, the latter since transferred to the Cunard; the America for the National Line; the Austral and City



NIGHT SKY FOR DECEMBER (Second Map of Pair),

Showing the heavens as they appear at the following hours:—

December 23 at 10 o'clock.	January 3 at 9½ o'clock.	January 14 at 8½ o'clock.
December 26 at 9¾ o'clock.	January 7 at 9 o'clock.	January 18 at 8¼ o'clock.
December 30 at 9¼ o'clock.	January 10 at 8¾ o'clock.	January 22 at 8 o'clock.

of Rome for the Anchor Line; the Gallia, Servia, Aurania, and Umbria for the Cunard Line; the Elbe, Ems, Fulda, Werra, and Eider for the North German Lloyd; the Hammonia for the Hamburg-American Line; the Normandie for the French Transatlantic; the Westernland and Noordland for the Red Star Line; and the Chateau Yquem and the Chateau Margaux for the Bordeaux Line. The Britannic and Germanic, of the White Star, and the City of Berlin, though not included in the list of those built since the Arizona, may be included among the fast vessels, as they have made remarkably quick passages. For the purpose of comparison the time made between New York and Southampton of the North German Lloyd, the distance being 3,100 miles; and the time made between New York and Plymouth, and New York and Havre, of the Hamburg-American steamers, a distance of 2,980 and 3,150 miles (maritime miles) are given herewith.

As to the fastest average passages made in the past three years, the Arizona is entitled to claim the pennant, while the Oregon has made the fastest average trips of the past twelve months. The Oregon has also made the quickest time, 6 days 10 hours and 10 minutes, from Sandy Hook to Queenstown. This is with four hours and twenty-two minutes difference of time between the two points added. The distance made was 2,861 miles, an average speed of 18½ (maritime) miles an hour. The

Oregon has also made the best day's run on record, on April 19 last covering 472 miles in twenty-four hours, an average of 19⅞ maritime miles, or 22$\frac{6}{10}$ land miles, an hour. A sea mile is 6,080 running feet, and a land mile 5,280 feet.

The following table will show at a glance a comparison of speed of each vessel, and also the quickest trip which each vessel has made both ways:—

Steamers.	Line.	New York to Queenstown. d. h. m.	Queenstown to New York. d. h. m.	Speed per hour.
Oregon	Cunard	6 10 10	6 12 54	18·5
America	National	6 14 18	6 15 41	18·0
Alaska	Guion	6 18 37	6 21 40	17·5
Aurania	Cunard	6 22 50	6 21 55	17·1
Servia	Cunard	7 00 55	7 2 27	16·9
City of Rome	Anchor	7 1 00	7 2 00	16·9
Arizona	Guion	7 3 38	7 6 7	16·6
Britannic	White Star	7 12 41	7 7 11	16·4
Austral	Anchor	7 9 00	7 6 00	16·1
Umbria	Cunard	—	7 11 00	15·9
Germanic	White Star	7 15 17	7 11 37	15·8
City of Berlin	Inman	7 15 48	7 14 12	15·6
Gallia	Cunard	7 18 32	7 16 32	15·5
		New York to Southampton.	Southampton to New York.	
Eider	N. G. Lloyd	7 16 30	7 16 32	16·8
Ems	N. G. Lloyd	7 18 25	7 23 40	16·6
Werra	N. G. Lloyd	7 21 15	7 23 00	16·4
Fulda	N. G. Lloyd	7 23 00	8 00 00	16·2
Elbe	N. G. Lloyd	8 2 30	8 2 45	16·1
		New York to Plymouth.	Havre to New York.	
Hammonia	Ham-Amer	8 17 00	8 19 00	14·9
		New York to Antwerp.	Antwerp to New York.	
Westernland	Red Star	9 10 50	10 3 00	13·9
		New York to Havre.	Havre to New York.	
Normandie	French	8 15 00	8 4 00	16·0

The average distance made to and from Queenstown and New York is 2,850 miles; to and from Southampton, 3,100 miles; to and from Plymouth, 2,980 miles; to and from Havre, 3,150 miles; to and from Antwerp, 3,250 miles.

In Norway and Sweden accumulations of moss, often more than a foot thick, and half decomposed, serve to make paper and millboard, as hard as wood, blocks of which, formed by the hydraulic press, may even be turned in the lathe and polished. This substance is said to possess the good qualities of wood without the defects, such as warping and splitting, so that it is suitable for making doors and windows. Plant has, it is said, been laid down in Sweden for working up these deposits of a hitherto waste substance into a useful material.

Telephone Subscriptions.—According to *L'Électricité*, the following are the rates of subscription to the telephone exchanges in the following European cities and countries:—London, £20; Paris, £24; Riga and Odessa, £25; Austria, £9 to £15; Germany, from £10, with an increase of £2. 2s. for every kilomètre (1·24 mile) over two; Italy, varying from £4. 12s. to £7, with the towns; Norway, £4 to £8, according to distance; Sweden, £6. 8s. to £10. 16s.; Holland, £10; Portugal, £15 for traders and £7 for private individuals; Switzerland, £4 to £10.

International Inventions Exhibition.—With a view to giving further protection to the inventions of exhibitors, a new certificate has been granted by the Board of Trade to the effect that "The International Inventions Exhibition, proposed to be held at South Kensington, S.W., in the county of Middlesex, from March 1, 1885, is an international exhibition," and by this means all the protection accorded from May 1 to inventions under original certificate (dated August 15) will be secured in addition from March 1 till May 1, *i.e.*, during the time in which the exhibits will be received and arranged. A printed copy of the extracts from the Patents, Designs, and Trade Marks Act, 1883, bearing on this subject, may be obtained on application to the secretary, International Inventions Exhibition.

Reviews.

CUSTOM AND MYTH.*

By Edward Clodd.

[second notice.]

HEAVEN (Uranus) and Earth (Gæa) were husband and wife, and their many children all hated their father for concealing them between the hollows of their mother's breasts, so that they were shut out from light. Gæa sided with them and provided Cronus, the youngest, with an iron sickle, wherewith he unmanned Uranus and separated him from Gæa. Cronus married his sister Rhea, and, at the advice of his parents, swallowed his children one by one as they were born, lest they grew up and usurped his place among the immortals. But when Zeus was born and he asked for the child, Rhea deceived him by giving him a stone wrapped in swaddling bands. When Zeus grew up he gave his father an emetic, whereupon the children were all disgorged and with them the stone, which became a sacred object at Delphi. There is no such being as Cronus in Sanskrit, but what may be called the Vedic variant of the myth is that in which Dyaus (Heaven) and Prithivi (Earth) were once joined and subsequently separated.

In New Zealand myth Rangi (Heaven) and Papa (Earth) are the parents of all things, and as Heaven lay on the Earth all was darkness, so that their unhappy children could not see.

These took counsel together, and all—one excepted—strove to rend their parents apart. They toiled in vain, save Intenganahan, who, despite the entreaties of Rangi and Papa, severed the sinews which united them. Then the children abode in light, only one of them, the Storm-god, remaining faithful to his father—as in the Greek myth did Oceanus.

In China we find a legend of "a person called Puang-Ku, who is said to have separated the Heaven and the Earth, they formerly being pressed down close together"; and, as one might expect, such a transparent nature-myth of the rending asunder of the world and sky is wide-spread.

The solar mythologists were perplexed at its presence among the refined and cultured Greeks. "How can we imagine that a few generations before the time of Solon the highest notions of the godhead among the Greeks were adequately expressed by the story of Uranus maimed by Cronus, of Cronus eating his own children, swallowing a stone, and vomiting out alive his own progeny. Among the lowest tribes of Africa and America we hardly find anything more hideous and revolting. So the moral character of the Greeks and the exclusive comparative method of Professor Max Müller and his adherents were vindicated by the discovery that, as Cronus means time, the apparently repulsive myth simply means that time swallows up the days which spring from it; "and," remarks Sir G. W. Cox, in his "Manual of Mythology," "the old phrase meant simply this and nothing more, although before the people came to Greece they had forgotten its meaning."†

Cronus is a more than usually troublesome *crux* to the etymologists. Max Müller, Kuhn, Preller, and Brown each have their theories, the details of which not even Mr. Lang can make attractive. And, happily, we may leave the scholars to settle their differences, since they do not affect the fundamental idea resident in the myth. The

* "Custom and Myth." By Andrew Lang, M.A. (Longmans, 1884.)

† P. xvi.

savage, in the presence of recurring light and darkness, of the clouds lifting and dispersing before the sunrise, has his legend of a time when this was not so, but when heaven and earth were closed in, one upon the other, till some hero thrust them apart. And, to his rude intelligence, the conception of night as a devouring monster might easily "start the notion of other swallowing and disgorging beings." This is, however, subordinate to the explanation which Mr. Lang's method gives. "Just as the New Zealander had conceived of heaven and earth as at one time united, to the prejudice of their children, so the ancestors of the Greeks had believed in an ancient union of heaven and earth. Both by Greeks and Maoris, heaven and earth were thought of as living persons, with human parts and passions. Their union was prejudicial to their children, and so the children violently separated their parents."*

Ex uno disce omnes. Such rational explanation of the irrational element in the myth of Cronus is equally applicable and conclusive in regard to myth all the world over, nor to myth alone, but to the old theologies in which the gods are associated with animals and worshipped under their forms. Of this Mr. Lang finds pertinent illustrations in Apollo, among whose many names is *Smintheus*, which may be rendered "Mouse Apollo," or "Apollo, Lord of Mice." Some of the Greek gods were sculptured with animal heads, although more often the images of the animals consecrated to them were placed in their hands, or the creatures themselves were kept in the inner sanctuary. So striking was the contrast between the insignificant mice, and the glorious, powerful sun-god Apollo, that the connection of the two puzzled the Greeks, and was accounted for in divers ways. The mouse was said to be endowed with the gift of prophecy, and was in consequence associated with the god who possessed wisdom as great as that of Zeus himself. Or, as Welbeck suggests, Apollo, as prototype of the Pied Piper of Hamelin, had freed the land from a plague of vermin, for deliverance from whose ravages the German peasants crowd their churches to this day. Of course, the solar theorist's, "darkening counsel by words without knowledge," see in the presence of the mouse in ancient shrines of the sun-god a further proof of polyonomy. But space must not be wasted on more than this bare reference, since the explanation which Mr. Lang suggests, although only as conjectural, seems conclusive. Seeking for parallel illustrations in both the Old and New World, their value increasing with the square of the distance, he finds the most striking one in the ancient Peruvian religion. The dynasty of the Incas boasted of descent from the sun, and the worship of that orb became the State religion, but, like Christianity with Paganism, it so far tolerated the older animal-worship which it supplanted as to collect the tribal animal gods into its temples, so that side by side with the Master of Life and the Sun were creatures small and great. "Just as in Peru the tribes adored 'vile and filthy' animals; just as the solar worship of the Incas subordinated these; just as the *huacas* of the beasts remained in the temples of the Peruvian Sun; so, we believe, the tribes along the Mediterranean coast had at some very remote pre-historic period their animal *pacarissas*. These were subordinated to the religion (to some extent solar) of Apollo, and the *huacas*, or animal idols, survived in Apollo's temples."† That is to say, Apollo as mouse-god is totemic. The barbarous ancestors of the Greeks believed, as do barbarous races still, in their descent from animals or plants, known as their *totem*—a belief which profoundly affects their social relations and customs, preventing unions between sexes of the same totem-name, and the eating of the creature from which descent is claimed. Of the belief in their mouse-ancestry among primitive Greek tribes, proofs occur both in place-names and badges, and although there is an alternative explanation of the consecration of mice to Apollo as votive offerings, it can scarcely be entertained in face of the corroborative evidence of like survivals in remote religions, and among different races. Of these survivals another and very curious example is the use of the same instrument in the Bacchic customs attending the worship of Dionysus, and in barbaric ritual. This instrument consists of a piece of wood sharpened at both ends, to one of which string is fastened. Twisted about the finger and whirled round and round, it makes a booming din dear to the noise-loving boys, by whom it was known as the "bull-roarer." But among both ancient and modern barbarians it acquired a sacred and magic character. It is found in use at this day among barbaric tribes in both hemispheres as a signal summoning the men together for performance of certain mysterious and secret celebrations, and at the same time waving off the women under pain of death. Mr. Lang cites evidence of its use in the Dionysiac mysteries from classic and patristic authorities, and draws the conclusions which the anthropologist must endorse—that, if we find so easily-invented an instrument as the "bull-roarer" in the mysteries of the most civilised of ancient peoples, the most probable explanation is, that the Greeks retained both the mysteries, the bull-roarer, the habit of bedaubing the initiate, the torturing of boys, the sacred absurdities, the antics with serpents, the dances and the like, from the time when their ancestors were in the savage condition.* Space does not allow other than meagre reference to the chapters on "Star Myths," the "Divining Rod," and the "Moly and Mandragora." In the first of these the names of stars (the finding of which was to the old lady a greater marvel than the ascertainment of their constitutions and distances), both singly and in groups, retained on our celestial charts and globes, constellations in which we can see no likeness of anything in heaven above or earth beneath, are shown to be the survivals of savage conceptions of the heavenly bodies as living beings. In the latter of these chapters the lingering superstitions in virtue, and even consciousness, residing in sticks and grotesque-looking objects, are illustrated with abundance of apposite fact.

The chapter entitled "A Far-Travelled Tale" should be read in conjunction with Mr. Long's introduction to "Grimm's Stories,"† as dealing with the intricate and interesting subject of the mode of diffusion of tales widespread as the myth of Jason. For behind that subject lies the larger question of the movements and intermixture of races, upon which the possession of legends common to them all may throw light.

* Pp. 49, 50. † Page 107.

SOME BOOKS ON OUR TABLE.

Tables and Memoranda for Mechanics, Engineers, Architects, &c. By Francis Smith. (London: Crosby Lockwood & Co. 1885.)—Into a tiny volume $2\frac{3}{4}$ in. long, $1\frac{7}{8}$ in. wide, and $\frac{3}{8}$ in. thick, Mr. Smith has contrived to pack an enormous amount of information, of daily and even hourly use among those for whom it is intended. Weights, measures, "quantities" of all descriptions, surveying, trigonometry, agricultural memoranda, rules and memoranda in connection with steam-engines and boilers, knots and splices, and even "useful suggestions in cases of accident or illness," are a few of the multifarious subjects

* p. 77.
† *Vid.* "Grimm's Household Stories." 2 vols. Bell & Sons.

dealt with in a book which may be easily carried in the waistcoat pocket.

Dental Caries. By Henry Sewill, M.R.C.S. and L.D.S. (London: Baillière, Tindall, & Cox. 1884.)—We have heard a dentist declare that, fifty years hence, there will not be a man, woman, or child in the kingdom with a sound set of teeth in his or her head. Even if we regard this as a species of professional hyperbole, the fact remains that caries (or decay) of the teeth is becoming most alarmingly common, and hence the interest of Mr. Sewill's book, not only to the members of his own profession, but to millions in every rank of life. He deals in great detail with the whole subject, explaining the causes, symptoms, and effects of caries in a very intelligible manner. Probably, though, the chapter on "The Prevention of Dental Caries" is that which is of the more immediate importance to the non-professional reader, to whose perusal we commend it.

Methods and Results. Report of a Conference on Gravity Determinations. (Washington: Government Printing-office. 1883.)—In consequence of a letter addressed by Lieut.-Colonel Herschel, R.E., to the Superintendent of the United States Coast and Geodetic Survey, relative to the best method of prosecuting pendulum observations, and their scientific value, a conference met at the Coast Survey Office in May, 1882, the report of which lies before us. Of the great importance of the results of accurately-conducted pendulum experiments to the Geodesist, the Physicist, and even the Geologist, it is needless to insist here; and the very practical suggestions in this Report can scarcely fail to be of the highest value to all who are either personally engaged in such experiments, or may afterwards have to employ their results either for study or calculation.

Destiny; or Man's Will-means and Will ends. By Arthur Young. (London: Houlston & Sons.)—This astonishing work consists of thirty-one diagrams, with accompanying (we hardly like to call it descriptive) letter-press. Diagram 1 looks like the Union Jack reposing on a circular diatom; on each of the eight arms of which is written the name of some axis—"spirit," or the like. Then, after the repetition of this arrangement in diagram 2, we have a series of black crosses, studded with discs, containing eight armed crosses, each arm, or rather each opposite pair of arms, being inscribed with the name of some science, art, mode of feeling, &c. As a specimen of the extremely intelligible character of the explanation (?) of these marvellous hieroglyphics given by their author, we quote, absolutely at random, from the bottom of page 7:—"6. The Deductive-Explications of Man's Intellect means-of-space, as Positive Pole of his Will-Necessity-Means, conclude this reading, and give us the Generalisations and Classifications of the Will-Means of Analogy as Concomitant of his Trinity (Father, Mother, Child) of Collectivity's Vocations of Aspiration,"— Need we quote further?

The Assay and Analysis of Iron and Steel. By Thomas Bayley. (London: E. & F. N. Spon. 1884.)—In a volume so compact and portable that it may be easily carried in the pocket, Mr. Bayley has furnished the metallurgist and assayer with a most valuable little manual on the analysis of iron and steel. No one possessing a moderate acquaintance with practical chemistry need be at a loss for a single instant with this work in his hands. The directions are as plain and perspicuous as they can be, and are supplemented by woodcuts of all the apparatus employed, tables of atomic weights, &c. Mr. Bayley has produced an extremely useful book.

Origin of Cultivated Plants, by Alphonse de Candolle, International Scientific Series. (London: Kegan, Paul, Trench, & Co., 1884.)—Indispensable to the professed botanist. M. de Candolle's exhaustive work must commend itself to a wide circle of more general readers from the mass of information it contains on a subject in which we have all so direct a personal interest. No less than 247 species of plants are traced to their origin in the volume before us, which displays an amount of erudition, to say nothing of painstaking labour, which cannot fail to impress the reader, and give him confidence in the conclusions of the author. Many of his results are sufficiently striking. We learn, for example, that while wheat, beans, lentils, the fig, millet, the olive, and rice have been in cultivation for many thousands of years, the potato, the Jerusalem artichoke, tobacco, the capsicum, the pineapple, and the tomato have only been cultivated within a comparatively recent period; while many of our ordinary vegetables occupy intermediate positions in the chronology of the subject. The study of a book so worthily sustaining the reputation of its predecessors in the same series cannot fail to indue economic botany with a new and additional interest; and to all who wish to learn the origin and history of many of their most familiar forms of food, clothing, medicine, &c., derived from the vegetable world, we can commend M. de Candolle's book. His discussion of the history of flax (pp. 119 to 130) will serve as an example of the thoroughness of his research.

Madness and Crime. By Clark Bell. Reprinted from the *Medico-Legal Journal*, New York, 1884.—The mad doctors (we humbly apologise, we mean the "Professors of Psychological Medicine") seem to be making a strenuous effort, at the present moment, to interfere with the administration of criminal justice in a fashion which we venture to think is opposed to some of the most rudimentary principles of our jurisprudence. These gentry appear to hold a tacit theory that no man ever commits a murder when he is sane; that their dictum is to settle the question of the amount of insanity which, so to speak, absolves a prisoner from responsibility, and, in fact, that a judge and jury are rather incumbrances and hindrances than otherwise, when the question of punishing a more than usually savage murderer is concerned. Of course, they do not say this, *totidem verbis*. Their utterances are much more euphemistic; but they are certainly putting forth claims in the direction at which we have hinted, the recognition of which can scarcely fail to do serious mischief. If it goes forth that eccentricity is an excuse for murder, no man's life will be safe. The sole object of capital punishment is the protection of society; and if hanging one murderer suffering under a delusion (always supposing that he knows that he is committing a crime) will save the lives of half a dozen peaceable citizens only, then should he be hanged straightway and without compunction.

Brickwork. By F. Walker. (Weale's Series.) (London: Crosby, Lockwood, & Co. 1885.)—This is an admirable practical manual for the bricklayer; one of its distinctive recommendations residing in the fact that it not only gives explicit directions for the merely manual operations of bricklaying, but explains the theory of them as well. The advantage to the artificer of not merely knowing how to do a thing, but why to do it, is inestimable. The chapter on Geometry as applied to the art cannot fail to be useful to the workman who aspires to excel in it. Nor is this little volume without its value for every one about to build either on a large or small scale; as the explanations given of the mode of getting out foundations, of the various forms of "bond," &c., may enable the owner to detect scamping, and the improper use of the material employed.

A Synopsis of Elementary Results in Pure and Applied Mathematics. By G. S. Carr, M.A. (London: F. Hodgson. 1884.)—Sections X., XI., and XII., of Mr. Carr's first volume lie before us, and include a mass of examples

in the Calculus of Variations, Differential Equations, &c., &c.; comprising propositions, formulæ, and methods of analysis, with abridged demonstration. The mathematical student will derive real assistance from this synopsis, which is the outcome of an obviously enormous amount of honest work.

Evolution in History, Language, and Science. Four addresses delivered at the commencement of the Twenty-fifth Session (1884–85) of the Crystal Palace Company's School of Art, Science, and Literature. (London: Crystal Palace Company. 1884.)—The addresses collected under the above title were delivered by Dr. Zerffi, the Rev. W. Hales, Mr. H. E. Malden, and the Rev. R. Thornton, and deal respectively with the study of general history, the scientific study of geography, hereditary tendencies as exhibited in history, and vicissitudes of the English language. Those who have the interests of education at heart, as contradistinguished from the detestable system of cram now in vogue, may profit by the perusal of these lectures. If they afford anything like a faithful reflex of the system and character of the instruction in the schools whence they issue, then may the Crystal Palace Company congratulate itself on worthily ministering to the educational wants of the country.

Christmas Gleams. Edited by W. E. Hodgson. (Glasgow: David Bryce & Son. 1884.)—Poems, ghost stories (satisfactorily cleared up), and other tales, by such contributors as Mr. W. H. Mallock, Mrs. Lynn Linton, Lord Rosslyn, &c., make up this Christmas number.

Romance and Reality. By Francis Neale. (London: J. W. Palmer & Co.)—This is the biography of a man who, beginning as a child by selling for sixpence a blue Cape triangular postage-stamp, which he picked up in the street in Hackney, has become one of the largest stamp-dealers in the world.

The Compendious Calculator. By Daniel O'Gorman, corrected and extended by J. R. Young. 26th Edition. Revised by C. Norris. (London: Crosby Lockwood & Co. 1885).—This is the twenty-sixth edition of that well-known work, O'Gorman's "Intuitive Calculations," a fact testifying, perhaps, as strongly to its value as any that could be adduced. It would be difficult to exaggerate the usefulness of a book like this to every one engaged in commerce, or manufacturing industry. Crammed full as it is with rules and formulæ for shortening and employing calculations in money, weights, and measures of every sort and description. Without selecting an example from either of the divisions devoted to a special trade, we will pick one out at random from what we may term the more general part of the work. To multiply by any number of nines. Rule: Add as many ciphers to the right-hand of the multiplicand as there are nines in the multiplier, and from the result subtract the original multiplicand, the remainder will be the product. Multiply 2368 by 999.

2368000
2368
Product 2365632

The whole work is full of similar "dodges" for shortening and simplifying calculation.

Before I Began to Speak. By a Baby. (London: Fleet Printing Works.)—The particularly precocious infant who relates his prelocutory experiences in this little tract, gives numerous hints as to the management of babies generally, which may be studied with profit by all to whose charge they are committed.

We have also on our table, *In the Watches of the Night*, Vol. 5 (Remington & Co.), *Our Monthly* (Rangoon), *The Tricyclist*, and the *Medical Press and Circular*.

Miscellanea.

A New Process of Photographic Printing.—The idea of coating paper with a gelatino-bromide of silver followed obviously enough on the successful employment of the same compound for the production of negatives, and many attempts have been made to produce in this manner a paper which might give results equal to those of the process which is always known as silver printing, and at the same time be so sensitive to light as to allow the image to be impressed on it in a few seconds, instead of requiring an exposure often of hours. . . . . The difficulty of procuring warmth of tone and consequent brilliancy in the picture seems now to have been overcome in a new material which Messrs. Marion, the photographic dealers of Soho-square, have produced and are about to supply commercially. . . . . The paper is obviously coated with a gelatine emulsion of some sort, and in all probability rival experiments will before long find out its precise nature. As regards the results producible by its means, their value does not seem to admit of much doubt. No industrial process can properly be termed successful till it has stood the test of regular commercial work; but it is at all events safe to say that no improvement of such promise has been introduced into photography since the advent of gelatine plates. . . . The whole process of producing a couple of dozen prints need not take an hour. Allowing time for washing, mounting, and finishing, an energetic man can, if required, supply his customers with their likenesses the next day after the portraits are taken. In these dark, short, winter days, it may be weeks before a photographer gets light enough to print a batch of pictures; but by Messrs. Marion's invention the whole thing can be done by gaslight. The process of working the paper is quite simple. As may be supposed, the image has to be "developed"—that is, no visible image is produced by the exposure to light. Consequently, the exposure has to be estimated, as it has in taking a portrait or a view. The development is effected in very much the same way as if an ordinary gelatine plate were under treatment, the developer being a weak solution of ferrous oxalate. After development the image is of a rich purple; but as this would change in the final, or "fixing" bath, it is necessary to "tone" the picture, as is done with an ordinary silver print, in a solution containing gold. After this the picture is "fixed" in the usual manner. Considerable variety of tone can be produced, the tints ranging from a warm red brown to a purple or even black.—Abridged from the *Times* of Nov. 24.

Anti-Vaccination Curiosities.—The anti-vaccination craze is by itself one of the most instructive and at the same time amusing developments of nineteenth-century sentimentalism; but it also affords an unpleasant study in the sordid relations it is forced into by those who promote it as a means of livelihood. Could we entirely separate it from this connection, and regard it solely as the possession of well-meaning but uninformed enthusiasts, it would be possible to tolerate it without any very great feeling of disgust; but since the movement has been adopted, like its companion delusion anti-vivisection, for merely trade purposes of advertisement, it has necessarily become degraded from the level it might easily occupy as a phase of eccentric mental activity. We have recently been deluged with the literature of subscription-loving agitators in reference to this subject, but the most recent of these productions is so startling in its intention, and so decidedly original in conception, that it almost deserves to be rescued from the oblivion which is the usual fate of such emanations. The communication is illustrated with the heading, "The Government Censured;" but adherents of the Ministry will recover from the momentary shiver induced by these ominous words when they discover that the censuring body is the "London Society for the Abolition," &c., which, it appears, recently assembled to pass the following resolution:—"That the conduct of the Medical Department in encouraging the profession to ignore vaccination as a cause of death in certificates and at inquests; and in their creation of unnecessary panic during the slight prevalence of small-pox, with the view thereby of inducing weak-minded persons to submit to vaccination and revaccination, merits severe condemnation by the Government." Accustomed though we are to the absurdities of conduct necessarily imposed on agitators who have to appeal for support to the unthinking and ignorant classes of the population, still this precious idea of "censuring" the Government strikes us as a master-stroke of policy. There are hundreds, nay, probably thousands, of deluded parents who will accept it as a vital blow to vaccination, and, in consequence, will submit themselves, their children, and their neighbours to the risk of infection, in the mistaken belief that their "rights" are being defended with success by the Society which receives their pennies. But its most vicious effect will be found in the false feeling of security

encouraged by the insinuation that small-pox is a bogey, and the further explicit declaration that pro-vaccinators are "weak-minded." If there is anything the foolish among mankind dread more than another, it is the very charge of possessing a "weak" mind, and the "Society" has shown a most crafty wisdom in selecting it as a weapon with which to wound its wavering adherents and compel them to submission.—*Medical Press and Circular.*

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A SELF-LIGHTING GAS-BURNER AND TAP.

Many, and, sometimes—as in the present instance—almost magical, are the domestically-directed inventions of the day. Prominent among these must be numbered the Patent Self-Lighting Gas-Burner and Tap, recently invented by Mr. Kinnear. This appliance obviates the necessity of relighting the gas, the turning of the tap at once effecting the purpose. The invention consists in the employment of a lighter or auxiliary burner for automatically lighting the main burner when the tap is turned on. By this operation the auxiliary burner, which allows only a mere pin-head jet of gas to burn, is shut off, while, when the tap is turned on, the main light is extinguished and the tiny flame of the auxiliary burner again lighted. The appliance consists of a double-way tap having a main way direct through the plug, and leading to the main burner, and also an auxiliary way round the surface of the plug leading to the lighter or auxiliary burner. When the main way is fully opened, by turning on the tap, and the main burner fully alight, the auxiliary way is entirely closed, and the lighter extinguished. When the main way is entirely closed the auxiliary way is open, allowing sufficient gas to pass through to keep a small pin-head jet only burning, which forms the lighter. As the plug is being turned on to open the main way to the burner, it automatically opens the auxiliary way to the full extent (by means of the way connecting the main with the auxiliary ways), whereupon the lighter flares up and ignites the gas, which is then slightly on at the main burner, and as the plug is turned on to the full extent, the main way is gradually opened, and at the same time the auxiliary way is automatically closed until when the main is full on and the burner fully alight, the auxiliary way is shut off, and the lighter is entirely extinguished. On the plug being again turned off the reverse operation takes place, and the lighter is again left with the pin-head jet burning. This useful appliance can be fixed to all existing fittings, by any inexperienced person, and will fit all makes of fittings, while the selling-price of well-finished taps and burners is at 4s. each, and even less.

AN APPARATUS FOR PRODUCING STEAM OR VAPOUR.

The ready and economic production of steam is a desideratum to many. Mr. Johan Millén, of Queen Victoria-street, London, has invented an apparatus which, it is claimed, produces, easily and cheaply, steam or vapour, alone, or mixed, if desired, with hot air. According to a modified arrangement, the steam or vapour jet is caused to enter a hot air jacket by preference at or near the top, and into a kind of cock or thimble or valve which admits the cold air to the jacket, or to a passage provided on it and communicating therewith by a row of holes. The required heat for evaporating or vaporising the water and heating the air is produced by a burner arranged underneath the water vessel and made to burn the vapour of petroleum, or other hydrocarbon or spirits.

AN IMPROVED FIRE-GRATE.

There seems no end of inventions designed to evolve at last the perfect fire-grate. One of the latest endeavours in this direction is the invention of Mr. James Smith, Pine-street, Liverpool, and has for its object to provide a fire-place and grate constructed in such a manner that bituminous coal, or similar carbonaceous fuel, will burn so as to produce a clear, bright fire emitting little or no smoke. The invention consists in constructing a combined fireplace and grate in a novel manner, so that coking and combustion of the fuel are effected in separate parts of the grate, and the air required for combustion is heated and admitted to the fuel as is necessary. The fireplace consists of a chamber or recess partly separated from the flue by an abutment or partition. The grate consists of firebars and sides of suitable construction, the bottom and back have each an air opening (or several) and valves or dampers. Below the lowest bar of the grate there is a coking-chamber, and when the grate is fitted into its place an air-space is left below and at the back, through which air passes past the valves or dampers through the bottom and back of the fireplace to support combustion. The grate is moreover provided with a movable or detachable front, which enables the same to be readily cleaned.

ORNAMENTAL WALLS, CEILINGS, &c.

One of the happiest and most encouraging signs of the day is the increasing attention paid to interior ornamentation. There is really no longer reason why decorated walls, ceilings, and pavements should belong only to the very rich, and it is quite certain that the advance of domestic decoration among the majority must *pari passu* include a corresponding advance in national culture. We are glad, therefore, to note that Mr. John Baker Gaiusby, of Lower Temple-street, Birmingham, has patented some notable improvements in constructing ornamental walls, ceilings, pavements, and other surfaces. The invention referred to consists of certain improvements in connecting pieces or plates of glass, enamel, or other ornamental material of which the ornament is made, and of methods of attaching the plates to the surface to be ornamented. As an illustration, the construction of a wall ornamented by a design composed of pieces or plates of enamel will be described. In order to connect the several pieces, strips of brass or other ductile material are used. Their shape in cross section is that of a T, or plain narrow strips with pins on the underside may be used. These strips are soldered together in lengths, so as to form a frame into which the pieces of enamel may be inserted from the back, the head of the T strips being in front and bearing upon the edges of the pieces of enamel. At the back the strips may have pins, studs, or projections, allowing the same to be fixed on the wall. The pins may be made to enter the plaster or cement on the wall before it has set. The frame containing the enamel plates may, however, be made with a backing of cement, and thus be formed into solid slabs, which are then used in the same manner as other slabs; or a back-plate of wood may be secured on the wall by screws or the like, and the ornamental slab be fixed thereon.

DOOR-LOCK FURNITURE, &c.

There is ample scope for inventive ingenuity, as we have already observed, for improvement in door and window furniture generally, to employ the builders' phraseology. Messrs. Jelley, Son, & Jones, the manufacturing ironmongers of Blackfriars-road, are now introducing a useful, and, as it certainly seems, a commendable invention known as Jones & Cunningham's patent self-adjusting door-lock furniture, which embodies a very excellent, though simple, improvement. It can be adjusted to any thickness of door, being provided with a tooth spindle, into which a rocking lever is pushed and secured by a sliding rose. Another invention is Jones & Cunningham's patented guarded-lever sash-fastener, which is provided on the hook-plate with a slide or shield for the protection of the arm or bar of the fastening.

A NEW COFFEE-MAKING APPARATUS.

Coffee in England is rarely what it should be, and the fault lies mostly in the manner of making. A well-known Professor has recently been devoting some thought to the subject of coffee-making, and this is, after all, more generally useful than transcendental philosophy; and as the net and satisfactory results, a new coffee-making apparatus (the "Criterion" Cafétière, Arndt's patent) has been constructed, after three years of experiment. It has been established as a fact that the exact time necessary to filter boiling water through coffee so as to completely extract its wholesome constituents is eight minutes, the quantity of coffee-beans and water being always fixed in certain proportions. On this period of filtration the makers base the sizes of their machines, which are made with mathematical accuracy to five different capacities, calculated to give from two to twelve cups of coffee. In these machines, the receptacle for ground coffee being closed at the top by a movable gauze lid, the water is obliged to pass through the immovable layer of coffee, and to extract its essence uniformly, at the same time making up the most valuable volatile constituents, thereby preventing the escape of the same. The wholesale agent for the "Criterion" Cafétière is Mr. Thomas P. Cook, 34, Snow-hill, London.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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EUCLID'S THEORY OF PARALLELS.

[1542]—In letter 1,495, Mr. C. L. Dodgson seems to imply that a proposition is not truly the converse of another unless it follows immediately from that other. This is by no means the case. The proposition that "all animals are men" is the converse of the proposition that "all men are animals;" yet one is true the other false. With regard to my comparison, at p. 337, between Euclid I., 17, and the 12th axiom, the point to be noticed is that the two propositions are equally far from being axiomatic: or if there is any difference Prop. 17 is the more nearly axiomatic; for it is only a general proposition, whereas Axiom 12 is exact, implying as it does that no matter how minute the deficiency of the two angles from two right angles, the two lines will meet. The best proof that Prop. 17 is the simpler of the two is found by comparing the results when the method of superposition is applied. The truth of Axiom 12 is only proved—even in mere sketch I presented—by a rather long process; but here is the proof for Prop. 17:—

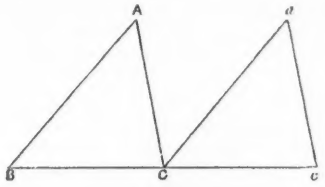


Fig. 1.

Produce the side B C of the triangle A B C (Fig. 1) to *c*, so that C *c* is equal to B C. Apply the triangle A B C to C *c* so that B C coincides with C *c*. We may suppose this done by sliding the whole triangle A B C along B C *c*. Then obviously the line B A will fall into such a position as C *a*, wholly on the right of A B. Hence the two angles A B C, A C B together are equal to the angles *a* C *c*, A C B together,—or fall short of two right angles by the angle A C *a*.

In like manner Prop. 16 may be proved,—or made obvious.

As to Mr. Dodgson's second objection, he does not show that K L is *not* obviously equal to C H. This is obvious from a consideration of the method of superposition employed. He goes on to a proof depending on the proposition that if two triangles have the three sides of the one equal respectively to the three sides of the other, they are equal in all respects. But I wished to use only considerations based on the effect of superposition. Of course Prop. 32 can easily be proved by a simple method of superposition. Indeed Prop. 32 has almost as good a right as Prop. 16 or Prop. 17 to be regarded as axiomatic. If we adopt the idea of an angle as produced by the turning of a straight line round a point, the line moving in one plane, Prop. 32 comes out from very simple considerations, thus:—

1. Suppose A B (Fig. 2) to represent two coincident straight lines, and one of these to turn round the point C, moving in one plane, to the position D C E: then B C D is the angle thus swept out.

2. It matters nothing so far as the angle between the two lines is concerned whether the turning be round the point C or another point as F (to position G F H), so that the amount of turning is the

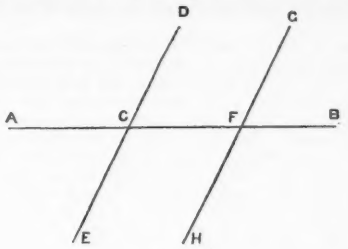


Fig. 2.

same,—that is, the angle G F B (tested by superposition) equal to the angle D C B.

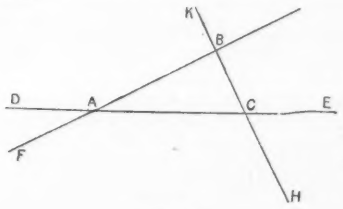


Fig. 3.

3. Now let A B C be any triangle, and let its sides be all produced both ways, as in Fig. 3, the line D A C E so formed being supposed double. Let one of these lines turn around the point A to the position F A B G, sweeping out the angle B A C. F A B G is now double. Let our component of this double line turn around the point B to the position H C B K, sweeping out the angle A B C. H C B K is now double. Let one of its components be turned around the point C to the position E C A D, sweeping out the angle B C A. Then a straight line originally coinciding with D A C E has been so turned as to measure in succession the three angles of the triangle A B C, and is found at the end of the process to coincide again with the line D A C E, but so that the ends which had been towards D and E are now towards E and D respectively. In other words, it has made half a rotation, or has swept out two right angles. Hence the angles of the triangle A B C are together equal to three right angles.

The third objection in Mr. Dodgson's letter is apparently based on the idea that Simson's axiom, "There cannot be two parallels, through a given point, to the same straight line," refers to parallels as negatively defined by Euclid. If this had been the case, Simson's axiom would be less axiomatic even than Axiom 12. It would, in fact, be simply another form of Axiom 12, only without the definite statement which at least enables the student to grasp the meaning of the statement. My definition of parallels includes, as a consequence, the property which Euclid assigns to parallels, and since I prove that not more than one line fulfilling the positive property I assign to parallels can be drawn through a point, so as to be parallel to a given line, I in effect prove that not more than one parallel as defined by Euclid (*i.e.*, negatively) can be so drawn.

RICHARD A. PROCTOR.

New York, Nov. 27, 1884.

MATTER.

[1543]—In Letter 1,534 your correspondent F. W. H. gives an extract from Haeckel's "Pedigree of Man," in which it is said that "we must hold that atoms are the smallest particles of masses, *having an unalterable nature*, separated from one another by hypothetical ether." On reading this passage the question will naturally occur to every thoughtful person, What basis can there be for that part of the statement which I have underlined? What claim has it, even if uttered by the highest authority, upon our acceptance? The answer seems to me to be contained in some sentences written by the late Professor Clifford in his "Ethics of Belief." There he says:—"He [referring to a person making a statement similar to the one just quoted] may quite honestly believe that this statement is a fair inference from his experiments but in that case his judgment is at fault." "I have no right to

believe this on his authority, for it is a thing which he cannot know without ceasing to be man." "No eminence of character and genius can give a man authority enough to justify us in believing him when he makes statements implying exact or universal knowledge."

Further on, in the quotation from Haeckel, we have: "Every atom has an inherent sum of force, and is, in this sense, gifted with a soul." Though we may not question the first part of this statement, is there any reason for our concluding that this "sum of force" is a sort of "soul," and can be expressed in terms of consciousness and will? Very probably, as Haeckel says, without a notion of attraction and repulsion, the phenomena of chemistry are inexplicable; but what warrant is there for making "pleasure" and "desire" concomitants of attraction, and "displeasure" and "loathing" concomitants of repulsion? *Is it for a moment conceivable that atoms are, or can be, conscious of their own movement?* To assert that two atoms of hydrogen and one of oxygen, or one of carbon and two of oxygen, *desire* to come into contact with each other appears to me to be not much different from a re-establishment of the polytheistic ideas of our rude forefathers.

J. T. Routledge.

WHAT SHOULD THE EARTH CONSIST OF THEORETICALLY, IF LAPLACE'S "NEBULAR THEORY" IS CORRECT?

[1544]—A strong argument advanced in favour of the nebular theory of Kant, Laplace, and Herschel, is that the specific gravity of the planets varies inversely with their distance from the sun. The argument being that each planet possesses an average specific gravity which is equivalent to that possessed by the outer layer of the sun at the moment of that planet's separation from it. This theory appears to be approximately true, but it has yet to be shown why the earth, whose specific gravity is about 3, should be composed of many elements whose specific gravities differ widely from this figure. Surely the layer of the sun from which a planet was formed, being in a molten state, would contain elements whose specific gravities were the same as the average specific gravity of that layer, and, if these elements were in a liquid condition, still this would not explain the great differences in the specific gravities of terrestrial elements. The only way to account for the presence of elements in the earth—like platinum sp. gr. 22, or potassium, or lithium, at the other extreme—appears to be to assume that the heat caused by the rupture of each planetary ring would raise the temperature of the resulting planet to such a point as would cause the dissociation of the contained elements, which, on subsequent cooling, would form elements of higher specific gravity by condensation. Giles Daubeney.

[Whatever weight may attach to Mr. Daubeney's inferences, his numerical data are, to say the least, vague. To begin with, the specific gravity of the earth, instead of being 3·0, is really 5·67. It is true that that of Mercury is 7·0; but, while Saturn's is only 0·68, the specific gravity of Uranus is 0·99, and that of Neptune 0·96; which accords but indifferently with the notion of variation "inversely with their distance" from the sun.—Ed.]

CURIOUS SUNSET.

[1545]—This evening, about 4 p.m., walking along the East Cliffs towards the town, I witnessed a remarkakle and somewhat unusual, sunset. The western sky, above the sun (which was hidden, as also a great part of the western horizon by the ridges of Kinkell Braes), seemed to be covered by a light-grey vapour—almost white, which shaded into the clear sky above without perceptible edge or break, as in ordinary clouds. Through rifts in this vapour, were clearly discerned bands of prismatic colours, as distinct as in the rainbow, but perhaps softer in tint, also the bands were broader. From the shape of the visible bands of colour it seemed as if they radiated from the setting sun in the same way as the fan-shaped pencils of light often seen on grey clouds in the west. They were all about the same height—rather less, I should think, than 45° above the horizon. The loose clouds floating in the clear sky above were deep purple-black, with a coppery tinge. I do not know if anything of the same kind has been observed in other places, or what the cause of this phenomenon could be.

25, South-street, St. Andrews, N.B. A. Werner.

POWER OF PERCEPTION.

[1546]—To how many objects can we attend at once? Locke, Brown, Stewart, Reid say only one; but this assertion has been completely reduced to absurdity by Leibnitz, Hamilton, and others. Charles Bonnet and Bestutt-Tracey both say that six objects are the maximum, and Hamilton agrees with them. Tucker says four. I have just been testing the matter myself, though without arriving at any very distinct conclusions. I found, to begin with, that I could easily "concentrate my consciousness" on two objects—a matchbox and an inkpot. I added a knife, then a book, then a watch, and sixthly a bottle. I found that I could be still conscious of each and all of these objects without any noticeable mental confusion. I added three new objects simultaneously, and at first did not feel that the result was affected. But as I endeavoured to realise that, individually and collectively, *nine* objects were lying before me, I seemed to experience a mental check. I felt that, were those nine objects animated beings, I could not grasp all and the phenomena of all simultaneously. After trying other variations, I have come somewhat dubiously to the conclusion that six is the number nearest to correctness. If six is not right, seven is more right than five. What do readers of Knowledge think about it, may I ask? Fred. W. Cleworth.

[This is largely a matter of education. The incipient observer with the Transit Instrument is at first terribly puzzled at having to count the seconds ticked by the pendulum of his clock, to watch the star as it crosses the spider lines in succession; to estimate the second and tenth of a second at which it is actually on each "wire," and to write down his results all simultaneously; although, after sufficient practice, he does all this automatically. See, too, the account of the way in which the famous French conjurer, Robert Houdin, prepared for some of his tricks, as related by Dr. Carpenter on pp. 205 and 206 of his "Mental Physiology" (Fourth Edition).—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

F.R.C.P. To append prices, as you suggest, would be to convert descriptive articles into advertisements pure and simple; which is wholly foreign to our purpose.—An Anonymous Correspondent (whose letter bears the Chesterfield postmark) sends a leaf of the *English Mechanic* for Dec. 19, 1873. Why, I have not the smallest conception.—J. B. Libby. See Knowledge for Nov. 21, p. 431, column 2. My own impression is, though, that your object-glass is faulty.—J. W. Alexander. Do you seriously suppose that the æther is *not* matter?!—Architect. No doubt, the people you name would understand the misapplied marks; but I am wholly in accord with the reviewer that this does not render their use less (scientifically) indefensible.—F. W. H. You wander too near the confines of forbidden ground to allow of the insertion of your letter.—Septuagenarius. Your kindly letter is most gratifying. The only paper at all answering the description of that to which your query relates is *The Inquirer*, a Unitarian organ.—P. J. L. You apparently admit Swedenborg's assumptions. I regard him simply as a monomaniac, suffering under hallucinations; who was as much—or as little—inspired as "General" Booth. Hence I can recognise no validity whatever in your arguments.—J. T. Routledge. To append the prices of books would be to make reviews merely publishers' advertisements. The work to which your question relates costs half-a-crown. In writing matter which is to be printed, please do so upon one side of the paper only.—W. S. C. Religion is a matter of fact; theology one of opinion. It would be utterly foreign to our purpose to pretend for an instant here to prescribe the limits of belief to yourself or anyone else. All that need be said is that scientific investigation must be conducted strictly by the scientific methods of observation and experiment, and that no craven fear of the consequences must be suffered to daunt the earnest and sincere seeker after Truth.—George Lacy. I must refuse to be entrapped into a purely theological discussion. Would all the conventionalisms you yourself employ bear an absolutely rigid interpretation? You would probably speak of the Sun as he, the Moon as she, of "His Grace" the Duke of Puddledock, and so on, without any serious intention of imputing sex and personality to either of those luminaries, or graciousness to a man who may have figured in the Divorce Court.—William Johnston. Pray buy a shilling elementary book on mechanics. Its perusal may save you from such exhibitions as you make on your ninth page, and show you how utterly impossible it is that comets of long period can revolve round two separate suns! Apropos of your fourteenth page, would you be surprised to hear that the density of Mercury is 1·24 times that of the earth: that of Saturn only 0·12 of ours?—H. M. P. I imagine (but am not certain) that the preface is actually in type. I could not communicate the substance of your letter to its writer in time to insure any alteration—always supposing that *he* considered it necessary.—St. J. H. Many thanks for all the trouble you have kindly taken, but the subject has already been thrashed out in these columns.—A. B. (Glasgow). I am very sorry to be compelled to decline to furnish the name of the manufacturer. You surely do not wish me to advertise what I denounced as a species of fraud.—

J. W. P. I always regard the burning brandy which covers the pudding as "the Spirit of Christmas" myself.—George Willamson. (1) The position angle of a double star (never of a planet) is the angle made with the meridian by a line joining the two stars, the larger one of the pair being supposed to occupy the centre of the circle round which the angles are measured from north through east, south, and west to north again. (2) What we need to know is the direction in which the sun is moving, not the absolute distance of the stars. Star groups that appear to open we must be approaching, and receding from those that are closing up. (3) Each star (according to the experiments of Zöllner with his polarisation photometer) in the common scale of magnitudes emits 0·363 of the light of that preceding it.—J. W. Alexander. Rather too vague to print.—Constant Reader. How can I possibly advise you, unless I know what use you wish to make of your discovery?—Alfred Pagan suggests that the passage in Job xxxviii. 31 (which is translated from the Septuagint), "Canst thou . . . . loose the bands of Orion?" should rather be, "Canst thou loose the bands (or rings) of Saturn?" He founds this interpretation on the meaning of the word Kesil (which signifies, in Arabic, inactivity, cold, or torpor), since Saturn was called "the slow mover" by the Hindus. This is ingenious enough; but the interpretation of Aben Ezra strikes me as being more feasible: "Kimah" (the Pleiades) were the harbingers of spring; while Kesil, the great Toledan held, signified the Scorpion—or rather Antares, the chief star in that constellation—which heralded the advent of winter. This antithesis is very striking and poetical.—M. E. Mavrogoreleto. Your hint shall receive attention.—James Simson. The social emancipation of the gipsies is a question of far too limited interest to justify me in occupying space with it here. Great Queen-street doesn't exactly swarm with that interesting (if, perhaps, scarcely rigidly honest) race.

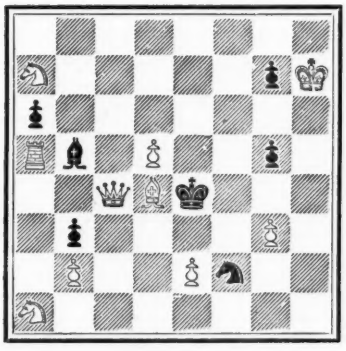
Our Chess Column.

By Mephisto.

PROBLEM No. 143.

By H. W. Sherrard.

Black.



White.

White to play and mate in three moves.

Is there a misprint in Problem 140? I find the following solution, which I presume is *not* the author's:—1. Because no use whatever is made of the W B on QKt6. 2. Because in the only four move line of play there is a "dual" at White's third move.

1. K to B5

Threatening "*either* Kt to B6 mate." Black cannot guard this square nor move his K. His only defences are R × P (giving the K *a square to move to*) and B to KB sq. (ch).

First Defence.

	R × P
2. Kt (Kt4) to B6 (ch)	K × R
3. Kt × KP *mate*.	

Second Defence.

	B to B sq. (ch)
2. R × B	
(Threatening the same mate with either Kt.)	
	R × B (best)
3. *Either* Kt to B6 (ch)	K to K5
4. R to KB4 mate	

W.

[We hope Mr. Laws will give a good account of himself, but we rather believe in W.—Ch. Ed.]

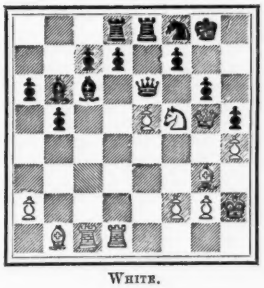
AN ILLUSTRATIVE GAME IN EVANS GAMBIT (COMPROMISED DEFENCE).

Played at Gatti's, November, 1884.

White. H. E. Bird.	Black. W. Seymour.	White. H. E. Bird.	Black. W. Seymour.
1. P to K4	P to K4	18. B to Kt sq.	Kt to K2
2. Kt to KB3	Kt to QB3	19. Q to B2	Kt to Kt3
3. B to B4	B to B4	20. Kt to R4	B to Kt2
4. P to QKt4	B × P	21. Kt to B5	KR to Ksq. (*a*)
5. P to QB3	B to R4	22. Q to Q3 (*b*)	QR to Qsq. (*c*)
6. P to Q4	P × P	23. B to Kt3	P to R3
7. Q to Kt3	Q to B3	24. P to KR4	Kt to B sq. (*d*)
8. Castles	P × P	25. K to R2	B to B3
9. P to K5	Q to Kt3	26. Q to Q2	P to KR4 (*e*)
10. Kt × P	KKt to K2	27. Q to KKt5	P to KKt3 (*f*)
11. QKt to K2	P to Kt4	28. R × B (*g*)	Q × R
12. B to Q3	Q to K3	29. Kt to R6 (ch)	K to Kt2
13. Q to Kt2	Kt to Kt3	30. R to Q6 (*h*)	P × R
14. Kt to B4	Kt × Kt	31. Q to B6 (ch)	K × Kt (*i*)
15. B × Kt	P to KR3	32. Q to R8 (ch)	Kt to R2
16. QR to B sq.	Castles	33. B to B4 (ch)	P to Kt4
17. KR to Q sq.	B to Kt3	34. Q × Kt mate	

Position after Black's 27th move.

Black.



White.

NOTES.

(*a*) Black dare not play Kt × B, on account of Kt to K7 (ch) and mates on R7.

(*b*) An oversight.

(*c*) Overlooking that he can now play Kt × B, for if 23. Kt to K7 (ch), K to B sq., winning a piece.

(*d*) Weak. He should have played Kt × KP, thereby greatly reducing the pressure of the attack. If in reply to Kt × P White plays 25. B × Kt, Q × B. 26. R to K sq., Q to B3, or if 26. Kt × P (ch), P × Kt, in both cases Black has a valid defence.

(*e*) This exposes his position still more to White's tempestuous attack.

(*f*) This move makes Black's position almost hopeless. White now proceeds in his well-known forcible style. (*See* Diagram.)

(*g*) Well calculated, but if now P × R. 29. R × R, R × R. 30. Kt to K7 (ch), K to R sq. (best). 31. Kt × P (ch), P × Kt, and Black has not a lost game. If 30. Q × R, P × Kt, and we fail to see Black's great disadvantage.

(*h*) An elegant device. White now secures a brilliant victory.

(*i*) If K to R2. 32. Q × P wins.

In the eighth of his series of lectures on "The World before Man," delivered at the Ipswich Museum, Dr. J. E. Taylor told an amusing story of the agates being "abundant in the neighbourhood of Aberystwith." They were imported from Saxony, and during the night scattered on the beach. Visitors picked them up, and the local lapidaries were then employed to polish them.

A New Brush Armature.—In order to obtain more lightness, coolness, and efficiency from the armature of the Brush dynamo, the American makers have introduced a core built up of iron riband instead of the old solid cast-iron core. A long band or riband of iron ·0625 in. thick is wound round a circular frame, and at intervals between each turn cross-pieces of the same thickness are inserted to separate the convolutions admitting air, and at the same time projecting on each side so as to form the V-shaped projections which hold the coils in place, and separate them from each other. About forty-five turns of the band are laid on. The new form is said to enable the machine to supply fifty arcs instead of the forty obtained from the older form at the same speed, namely, 750 revolutions per minute.—*Engineering*.

Our Whist Column.

By Five of Clubs.

THE following singular game was played recently in America. It is hardly necessary to say that *A-B* only win because of *Y-Z*'s very bad play. A case is on record, which we may present in our next, where Mr. Clay saved a game in a similar way. But he only got two leads, through the enemy's trump strength, here three had to be obtained :—

THE HANDS.

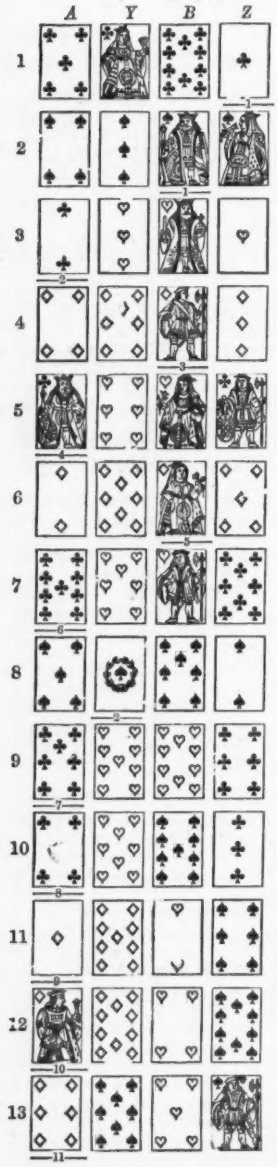
B { *C.* 10. / *D.* Q, Kn. — H. K, Q, Kn, 10, 5, 4, 2. / S. K, 9, 7. }

Y { *C.* Q. / *D.* 10, 9, 8, 7. / *S.* A, 8, 3. / *H.* 9, 8, 7, 6, 3. }

A-B, 0. **B** — *Tr. C. Kn.* — **Y** **Z** — *Y-Z*, 3. — **A** leads.

Z { 3, 6, 8, Kn, A. *C.* / 3, 5. D. / 2, 6, 10, Kn, Q. S. / A. H. }

A { *C.* K, 9, 7, 5, 4, 2. / *D.* A, K, 6, 4, 2. — H. None. / S. 5, 4. }



THE PLAY.

Card underlined wins trick.

1. *A* leads lowest but two, the ante-penultimate, to show he holds six. The fall of the cards shows that *Y* and *B* (observe trump card) have no more. *Y-Z* are two by honours, and *A-B* must make five by tricks to save the game. The case looks hopeless; and indeed only bad play on the part of *Y-Z* can give *A-B* a chance. Observe that *A* after this round holds best 3rd, 5th, 7th, and an odd trump, *Z* holding 2nd best, 4th, 6th, and 8th. This both *A* and *Z* knows.

2. *Z* holds Spade Knave and Ten, a rock ahead in *that* suit.

3. Of course *A* ruffs.

4. It is *almost* certain that *A-B* lose if *A* leads in the usual way from his long and strong Diamond suit. Suppose the 4th and 5th suits to fall to him, and the 6th to *B*'s Queen (*Y* holding two and *Z* three), and that then the 7th trick fell as the 5th in the actual play, *A* must then lead a Spade, or give *Z* a ruff. Now even if *B* holds the Space Ace, and leads a winning Heart, through *Z*'s trumps (making trick 9 like trick 7 in the actual game), *A* must then either lead from his tenace in trumps, in which case *Z* must make two tricks (whether best or lowest trump is led) or a Diamond, which *Z* would ruff, forcing *A* with Spade Knave, but making no more tricks. In this last case *alone* *A-B* would make their five tricks. All the chances are against this happening, and as the cards actually lay *Y-Z* would not only have made the necessary three tricks but four certain, and five if *Z* had declined the force. Without going through all this process of reasoning, *A* feels that the only good chance he and *B* have of making five by cards is by forcing *Z* with winning cards of *B*'s. If *B* does not hold Diam Qn the game is lost anyway. Therefore *A* leads a small Diam.

5. *B* leads his winning Heart, which *Z* unwisely ruffs. *B* rightly leads the Queen instead of the Ten, the usual card as second lead from that suit; for his object is to tempt *Z* to ruff, and *Z* would probably have passed the Ten.

6. *A* again leads a small Diamond, and

7. *B* leads the winning Heart, which *Z* again unwisely ruffs.

8. *A* knows that the lead must go to *Y* or *B*; either way, the Spade lead is safer than the Diamond, which *Z* would probably ruff, leading then a Spade and making the third trick.

9. *Y* plays very badly here,—in fact atrociously. He can count (or he could count if he had played with any attention) every suit. He ought to know his partner has no Diamonds, and therefore would ruff that suit and win. He ought to know his partner has the winning Spades, and that a Spade lead would force *A* and give *Y-Z* the third trick wanted for victory. But "because *A* had the winning Diamond," and "because *A* could trump Spades," (these were the reasons he gave afterwards) he leads from his head sequence in Hearts ("I expected one of them would make"). But even now, by letting the Ten make, *Z* would have saved the game. Whether *B* led a Heart or a Spade, *A* must have ruffed, and the one trick necessary to win the game would have been made by *Y-Z*.

10, 11, 12, 13. The rest of the game plays itself; *A-B* make five by cards and win.

A Little Whist Problem.—I have seen reference made of late to a whist problem examined by Mr. Pole, whose book on short whist is known to all whist players. (It is an excellent work except for the pestilent doctrine that the learner should always signal for trumps if he holds five—whereas the *learner* ought never to signal at all, and no good player would think of signalling *merely* because he held five trumps.) The problem is, what is the chance when you hold originally four of a suit that the suit will go round three times? I have examined the problem (in fact I had done so several years ago) with the following result; the numbers mentioned in which will probably surprise those who notice the matter for the first time. When you hold four of a suit you may have obtained those four cards in any one of 423,314,340,020 different ways; and in 66,905,856,160 of those, the three other players will each have received three cards of those suits. The chances, then, that the suit will go round thrice, are about 6,690 in 42,331, or say 67 in 424, not far from 3 in 19. The odds are 16 to 3, or more than 5 to 1, against the suit proving "honest."—*R. A. Proctor in "Newcastle Weekly Chronicle."*

From the *Iron Trade Circular* of Messrs. Bolling & Lowe we learn that the total quantity and value of exports of British iron and steel were, during the first eleven months of 1882, 4,062,215 tons (£29,301,039); of 1883, 3,765,192 tons (£26,517,163); of 1884, 3,267,490 tons (£22,707,708).

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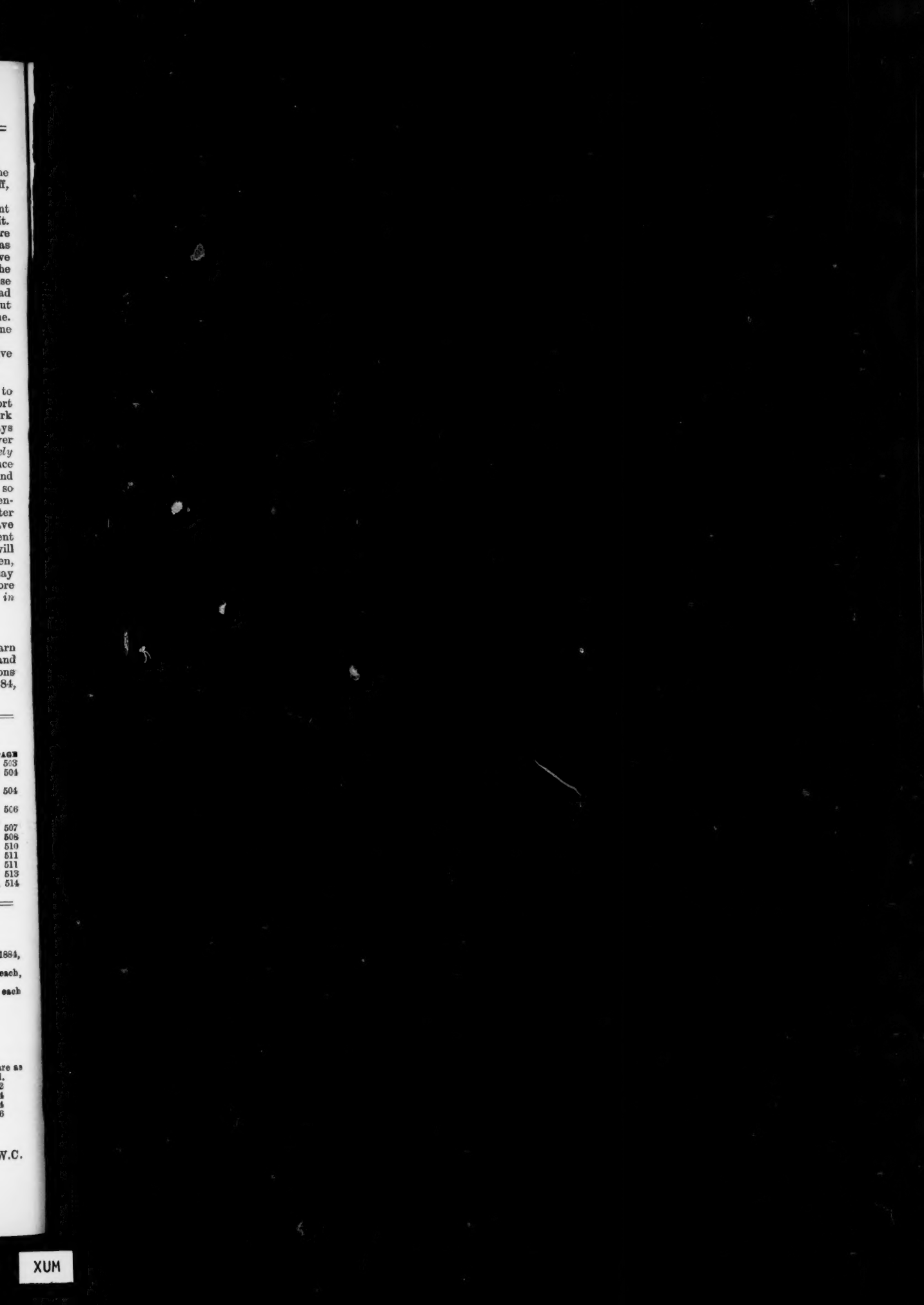
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